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EAST INDIA (INDUSTRIAL COMMISSION).

REPORT

OF THE

INDIAN INDUSTRIAL COMMISSION,

1916–18.

Presented to Parliament by Command of His Majesty.

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THE INDIAN INDUSTRIAL COMMISSION.

ITS REPORT SUMMARISED.

The Report of the Industrial Commission, which has been sitting for the last two years under the Chairmanship of Sir Thomas Holland, K.C.S.I., has been issued and copies can be obtained in a convenient octavo form at the price of one rupee. Before summarising the Report it is important to note that the constructive proposals depend on the acceptance of two principles:—(1) that in future Government must play an active part in the industrial development of the country, with the aim of making India more self-contained in respect of men and material, and (2) that it is impossible for Government to undertake that part, unless provided with adequate administrative equipment and forearmed with reliable scientific and technical advice.

With these principles in mind, it will be convenient first to glance at the administrative machinery which the Commission proposes and then to examine the work which it is intended to do. The administrative proposals include the creation of imperial and provincial departments of Industries and of an Imperial Industrial Service. The imperial department would be in charge of a member of the Viceroy's Executive Council, assisted by a Board of three members entitled the Indian Industries Board, and be responsible for the industrial policy of Government and the inauguration and carrying out of a uniform programme of industrial development throughout the country. The actual administrative work would be almost entirely decentralised and would devolve on Local Governments. The performance of these duties would necessitate the employment of a large staff of officers whose qualifications would primarily depend upon a knowledge of mechanical engineering; and the formation of an Imperial Industrial Service is suggested in order to safeguard Government against the dangers and difficulties of casual recruiting. This service would consist mainly of mechanical engineers and engineering technologists, the majority of whom would be employed under the Local Governments. The headquarters of the Department and of the Board should be with the Government of India.

The provincial departments would be administered by Directors of Industries, assisted by specialists and technical advisers who would usually be seconded from imperial services for work under the Local Government. A provincial Director would thus be able to develope the industries of his province with the help of competent engineers and scientists. He would be advised by a provincial Board of Industries, composed mainly of non-officials; and he should hold the post of a Secretary to Government to secure expeditious and effective despatch of work.

It now remains to consider the work which this organisation is to carry out and the conditions of India which render essential a policy of active intervention on the part of Government in the industrial affairs of the country. The first chapters of the Report deal with India as an industrial country, her present position and her potentialities. They show how little the march of modern industry has affected the great bulk of the Indian population, which remains engrossed in agriculture, winning a bare subsistence from the soil by antiquated methods of cultivation. Such changes as have been wrought in rural areas are the effects of economic rather than of industrial evolution. In certain centres the progress of western industrial methods is discernible; and a number of these are described in order to present a picture of the conditions under which industries are carried on, attention being drawn to the shortage and to the general inefficiency of Indian labour and to the lack of an indigenous supervising agency. Proposals are made for the better exploitation of the forests and fisheries. In discussing the industrial deficiencies of India, the Report shows how unequal the development of our industrial system has been. Money has been invested in commerce rather than industries, and only those industries have been taken up which appeared to offer safe and easy profits. Previous to the war, too ready reliance was placed on imports from overseas, and this habit was fostered by the Government practice of purchasing stores in England. India produces nearly all the raw materials necessary for the requirements of a modern community; but is unable to manufacture many of the articles and materials essential alike in times of peace and war. For instance, her great textile industries are dependent upon supplies of imported machinery and would have to shut down if command of the seas were lost. It is vital, therefore, for Government to ensure the establishment in India of those industries whose absence exposes us to grave danger in event of war. The Report advocates the introduction of modern methods of agriculture, and in particular of labour-saving machinery. Greater efficiency in cultivation, and in preparing produce for the market would follow, labour now wastefully employed would be set free for industries, and the establishment of shops for the manufacture and repair of machinery would lead to the growth of a huge engineering industry. After examining the resources for generating power, the Report says the coal of India is generally of a poor quality and the radius within which it can be economically used is accordingly limited. Moreover, the extension of metallurgical industries already started involves a severe attack on our visible supplies of coking coal. The Commission recommends a special survey of the coal position in India. The oil fields of Burma are being rapidly drained and no others of equal value have been proved. Wind power is too intermittent for industrial use. Attention should be directed to more economical methods of using wood fuel, and new materials for industrial alcohol should be investigated. The harnessing of water power appears, however, to afford a more reliable source of energy, especially with a view to the development of thermo-electric industries; and Government is urgently enjoined to undertake a hydrographic survey in order to determine the places which offer possibilities for the establishment of hydro-electric installations.

The next chapters deal with "The Indian in Industries." They discuss measures designed to improve the efficiency of the Indian artisan and to encourage the educated Indian to take part in industrial enterprise. It is shown that the relative lowness of wages paid to Indian labour is counterbalanced by the comparative inefficiency of the individual Indian workman. The Commission assigns three causes for this inefficiency, *viz.*, the absence of education, the prevailing low standard of comfort and the effects of preventible disease. The Commission expresses itself in favour of universal primary education, but considers that it would be unfair and unjust to impose upon employers this duty, which devolves rather upon the State and local authorities. But education of a technical kind is also required, and the method of instruction to be followed will vary for workers in organised and for workers in cottage industries, the latter of whom, it may be remarked, considerably exceed the former in numbers. For cottage industries the Commission proposes an efficient system of education in industrial schools administered by head masters with practical knowledge of the industries taught, and controlled by the Departments of Industries. The extension of marketing facilities must go hand in hand with the teaching of improved processes. In the case of organised industries mechanical engineering is taken as a typical instance, and the proposals include the establishment of a system of organised apprenticeship for a period of four or five years, with practical training in the workshops and theoretical instruction in attached teaching institutions.

The Commission places better housing in the forefront of its recommendations to raise the standard of comfort of the Indian artisan. Subject to certain safeguards, Government should use its powers under the Land Acquisition Act to acquire sites for industrial dwellings, and land so acquired should be leased to employers on easy terms. Special remedies are proposed in the case of Bombay, where the problems of congestion are unique. General measures of welfare work among factory employés are also suggested, and special attention should be paid to the improvement of public health. The elimination of such diseases as hookworm and malaria, which are prevalent almost everywhere in India, would add enormously to the productive capacity of the Indian labourer.

The general aversion from industrial pursuits of the educated Indian is ascribed to hereditary predisposition accentuated by an unpractical system of education. A complete revolution in the existing methods of training is proposed. For manipulative industries, such as mechanical engineering, an apprenticeship system, similar to that suggested for artisans should be adopted. The youth who aspires to become a foreman or an engineer, must learn to take off his coat at the start and should serve a term of apprenticeship in the workshops, supplemented by courses of theoretical instruction. At the conclusion of this period of training he may be allowed to specialise in particular subjects. For non-manipulative or operative industries, on the other hand, the teaching institution should be the main training ground, though practical experience is also necessary. Special proposals are made for commercial and mining education; and the future establishment of two imperial colleges is adumbrated, one for the highest grade of engineering and the other for metallurgy. To ensure the maintenance of close relations between the training institutions and the world of industry, the general control of technical education should be transferred to the Department of Industries.

The remaining chapters of the Report deal more specifically with Government intervention in industries. Government clung long to the tradition of *laissez faire* in industrial matters; but when in recent years it attempted to play a more active part in industrial development, its efforts were rendered futile by the absence of scientific and technical advice to assist it in estimating the value of industrial propositions and by the lack of any suitable agency to carry out approved proposals. To remedy the first of these defects, a reorganisation of the existing scientific services is advocated, in such a way as to unite in imperial services, classified according to science subjects, all the scattered workers now engaged in the provinces on isolated tasks. Rules are suggested to govern the relations between the members of these services and private industrialists seeking advice. The situation of research institutes and the conditions and terms of employment of these services are questions for the decision of which the Commission considers that the appointment of a special committee is necessary.

The administrative machinery with which Government must be equipped and some of the functions which that machinery will enable it to perform have already been described; but there are many other directions in which the development of industries can be stimulated. Useful and up-to-date information on commercial and industrial matters is essential both for Government and for private merchants and industrialists. A scheme is propounded for collecting such information and for making it available to the public through officers of the Department of Industries. The purchase of Government stores in the past has been conducted in such a way as to handicap Indian manufacturers in competing for orders and to retard industrial development in India. The Commission proposes that the Department of Industries should be in charge of this work and that orders should not be placed with the Stores Department of the India Office until the manufacturing capabilities of India have first been exhausted. A chapter is concerned with the law of land acquisition and enunciates principles in accordance with which Government might compulsorily acquire sites for industrial undertakings; in another, the various methods by which Government might render direct technical aid to industries are explained. The Commission considers that ordinarily Government itself should undertake manufacturing operations only for the production of lethal munitions. The administration of the Boiler Acts, the Mining Rules and the Electricity Act, the employment of jail labour, the prevention of adulteration, patents, and the registration of business names, of trade marks and of partnerships, are matters which are specifically dealt with. In the opinion of the Commission the compulsory registration of partnerships is practicable, and the question should be examined by Government with a view to legislation.

Industrial co-operation is discussed with reference to small and cottage industries; and the vexed question of the effects of railway rates on industries is considered. The Commission thinks that reduced rates to and from ports have been prejudicial to industrial development and that the position requires careful examination with a view to the removal of existing anomalies. In particular it should be possible to increase the rates on raw produce for export and on imports other than machinery and stores for industrial use. The addition of a commercial member to the Railway Board and the better representation of commercial and industrial interests at the Railway Conference would help to secure a more equable system of rating. The improvement of waterways and the formation of a Waterways Trust at Calcutta are also proposed.

The Commission lays emphasis on the disorganisation of Indian capital and its shyness in coming forward for industrial development. There is no lack of money in the country, yet the industrialist cannot obtain the use of it except on terms so exorbitant as to devour a large part of his profits. There is a crying necessity for the extension of banking facilities in the mofussil. The Commission is disposed to favour the establishment of an industrial bank or banks; but it considers that the appointment of an expert committee is necessary to deal with this subject and asks Government to take action at an early date. As an 'interim' measure, a scheme is propounded for the provision of current finance to middle-class industrialists, by which the banks would open cash credits in favour of applicants approved by the Department of Industries on the guarantee of Government. Various other methods of financial assistance by Government are suggested, in particular the provision of plant for small and cottage industries on the hire-purchase system.

To sum up, the Commission finds that India is a country rich in raw materials and in industrial possibilities, but poor in manufacturing accomplishment. The deficiencies in her industrial system are such as to render her liable to foreign penetration in time of peace and to serious dangers in time of war. Her labour is inefficient, but for this reason capable of vast improvement. She relies almost entirely on foreign sources for foremen and supervisors; and her *intelligentsia* have yet to develope a right tradition of industrialism. Her stores of money lie inert and idle. The necessity of securing the economic safety of the country and the inability of the people to secure it without the co-operation and stimulation of Government impose, therefore, on Government a policy of energetic intervention in industrial affairs; and to discharge the multifarious activities which this policy demands, Government must be provided with a suitable industrial equipment in the form of imperial and provincial departments of Industries.

The recurring cost of the proposals is estimated at Rs. 86 lakhs; they involve a capital expenditure of Rs. 150 lakhs, mainly on educational institutions, and a further capital outlay of Rs. 66 lakhs is anticipated for future developments. The Commission considers that this expenditure may be worked up to at the end of a period of 7 years.

REPORT

OF THE

INDIAN INDUSTRIAL COMMISSION

1916—18

CALCUTTA
SUPERINTENDENT GOVERNMENT PRINTING, INDIA
1918

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INTRODUCTORY.

Appointment and constitution of the Commission.

The Indian Industrial Commission was appointed by the Government of India by order conveyed in Resolution No. 3403 (Industries), dated the 19th May 1916, in the Department of Commerce and Industry, the full text of which is reproduced as Appendix A-1. The Commission was "instructed to "examine and report upon the possibilities of further industrial development "in India and to submit its recommendations with special reference to the "following questions:—

" (*a*) whether new openings for the profitable employment of Indian "capital in commerce and industry can be indicated;

" (*b*) whether and, if so, in what manner, Government can usefully give "direct encouragement to industrial development—

" (*i*) by rendering technical advice more freely available;

" (*ii*) by the demonstration of the practical possibility on a "commercial scale of particular industries;

" (*iii*) by affording, directly or indirectly, financial assistance "to industrial enterprises; or

" (*iv*) by any other means which are not incompatible with the "existing fiscal policy of the Government of India."

In addition to the exclusion of the tariff question from the scope of the Commission's enquiries, it was also stated to be unnecessary for it to undertake the examination of those aspects of technical and industrial education which had recently been dealt with by the Atkinson-Dawson Committee, appointed in 1912 to enquire into the means of bringing technical institutions into closer touch with employers of labour in India, and by the Morison Committee which reported to the Secretary of State in 1913 on the system of State technical scholarships established by the Government of India in 1904.

The Commission was composed of the following Members:—

(1) Sir T. H. Holland, K.C.I.E., D.Sc., F.R.S., President of the Institution of Mining Engineers. (President.)

(2) Mr. Alfred Chatterton, C.I.E., B.Sc., F.C.G.I., A.M.I.C.E., M.I.M.E., Director of Industries and Commerce in Mysore.

(3) The Hon'ble Sir Fazulbhoy Currimbhoy Ebrahim, Kt., Messrs. Currimbhoy Ebrahim and Company, Bombay.

(4) Mr. Edward Hopkinson, M.A., D.Sc., M.I.C.E., M.I.M.E., M.I.E.E., Managing Director, Messrs. Mather and Platt, Ltd., Manchester, and Vice-Chairman, Chloride Electric Storage, Ltd.

(5) The Hon'ble Mr. C. E. Low, C.I.E., I.C.S., Secretary to the Government of India, Department of Commerce and Industry.

(6) The Hon'ble Pandit Madan Mohan Malaviya, B.A., LL.B., of Allahabad.

(7) The Hon'ble Sir Rajendra Nath Mookerjee, K.C.I.E., Messrs. Martin and Company, Calcutta.

(8) The Right Hon'ble Sir Horace Curzon Plunkett, P.C., D.C.L., LL.D., F.R.S., K.C.V.O.

(9) The Hon'ble Sir F. H. Stewart, Kt., M.A., C.I.E., Messrs. Gladstone Wyllie and Company, Calcutta, President, Bengal Chamber of Commerce.

(10) Sir Dorabji Jamsetji Tata, Kt., J.P., Messrs. Tata, Sons and Company, Bombay.

Secretary.—Mr. R. D. Bell, I.C.S.

Unfortunately Sir Horace Plunkett was unable to join the Commission, owing at first to ill-health and subsequently to other duties of high national importance. Dr. Hopkinson submitted his resignation during the second season's tour, having been debarred under medical advice from coming out to India in November 1917, though during the first year we received great assistance from the advice which his range of experience both as a manufacturer and as a scientist enabled him to furnish. In October 1917, Mr. G. H. W. Davies, I.C.S., was appointed Joint Secretary, as Mr. Bell, whose services had some months previously been transferred to the Indian Munitions Board, could not be spared for the forthcoming tour, though he continued to assist the Commission by supplying information on various points and afterwards in the preparation of the report.

Monsoon tour of the President.

It was arranged that the President should come to India some months before the Commission assembled, in order to acquaint himself with the existing industrial position. He arrived in India in May 1916 and proceeded to Simla; whence, after making preliminary investigations, he started on tour at the end of June and visited Bengal, Bihar and Orissa, Madras, Bangalore, Bombay, the Central Provinces and the United Provinces, returning to Simla towards the end of September. The scattered information available was marshalled in the form of a preliminary note by the President on the scope of the Commission's enquiry, and placed before the Members at a meeting held in Calcutta in July 1916, when the methods of procedure to be adopted in the formal collection of evidence were discussed and decided. This note is printed as Appendix A-2.

Preparation of a list of questions.

At the end of September 1916 we assembled at Simla and prepared a list of questions covering, as far as possible, the scope of the Commission's enquiry, in order to assist witnesses in focussing their attention on those parts of it of which they had special knowledge, or in which they were specially interested. This list, as subsequently revised, consisted of 113 questions under 10 main heads (*vide* Appendix A-3).

Methods of enquiry.

Our enquiry included the personal inspection of industrial enterprises, the examination of witnesses, and discussions with representatives of local committees and institutions. We had also the advantage of conferring with the Provincial Industrial Committees which existed in some provinces and with some of the Local Governments and Administrations. In all we recorded the written statements of 472 witnesses, and 342 appeared before us for oral examination.* In deference to the wishes of witnesses or from other considerations, it was considered advisable to treat as confidential some of the matter brought before us, and we have accordingly prepared one volume of confidential evidence, which will not be available to the general public. In view of the fact that the Commission was freely admitted to inspect industrial concerns, and that information, often of a confidential nature, was placed at our disposal on these occasions, our inspection notes also will not be published.

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*The evidence is printed in six volumes :—

Volume I. Delhi, United Provinces and Bihar and Orissa.
Volume II. Bengal and Central Provinces.
Volume III. Madras and Bangalore.
Volume IV. Bombay.
Volume V. Punjab, Assam, Burma and General.
Volume VI. Confidential.

Tour of 1916-17.

We met at Delhi on the 26th October 1916, with the exception of Mr. Low who joined the Commission at Bankipore, and, after taking evidence in the Delhi Province, we visited the United Provinces, Bihar and Orissa, Bengal, the Central Provinces, Madras and Bangalore. Details of our itinerary with a list of institutions visited are given in Appendix A-4. In January 1917, in consequence of the increased difficulties of obtaining from Europe stores for war and essential purposes, the necessity of stimulating the local manufacture of munitions became a matter of vital importance. Taking advantage of the experience already gained by the Commission, the Government of India summoned Sir Thomas Holland to Delhi at the end of the month and requested him to organise a new department for the purpose. This decision—although the resulting organisation was in its final form precipitated by the conditions developed during the war—was welcomed by us as a practical anticipation of many of the conclusions which had been forced upon us by evidence that began to repeat itself most strikingly before we reached Madras. For the newly formed Indian Munitions Board, as the central authority controlling the purchase and manufacture of Government stores and munitions of war, became, in effect, an experiment on a large scale designed to test the value of many of our conclusions regarding not only the manufacturing capabilities of the country, but also regarding the kind of administrative machinery most suitable to carry out our proposals. The Munitions Board is thus our principal witness, and we have had the benefit of information regarding some of its activities. After the departure of Sir Thomas Holland from Madras, Sir Francis Stewart acted as President for the remainder of our visit to Southern India. On the conclusion of the tour Messrs. Low, Chatterton and Bell assembled at the office of the Munitions Board to summarise the results of the first year's enquiries.

Tour of 1917-18.

When the Commission re-assembled on the 7th of November 1917, Sir Thomas Holland rejoined and presided over our enquiries in the Bombay Presidency. Pandit Madan Mohan Malaviya was unable to take part in our sessions at Bombay, but accompanied us for a portion of the ensuing Punjab tour. Mr. Chatterton was compelled to be absent during our tour in this province. The Commission afterwards visited Assam and Burma. Pandit Madan Mohan Malaviya, Sir Fazulbhoy Currimbhoy and Sir D. J. Tata were unable to take part in the Assam tour, and the two former were also prevented from visiting Burma. As the President had to revert to his duties with the Munitions Board after the Bombay tour and was only able to join us for special discussions on one or two subsequent occasions, Sir R. N. Mookerjee was appointed to act as President of the Commission until its re-assembly at Simla for the preparation of the final report.

During the tour the personnel of the Commission was strengthened by the inclusion of an officer with local knowledge in each province, nominated by the Local Government to help in our enquiries, and co-opted by the Commission. The following gentlemen, to whom our thanks for their ready help are due, assisted in our proceedings:—

(1) Mr. G. A. Thomas, I.C.S., Secretary to Government, Bombay.
(2) The Hon'ble Mr. H. J. Maynard, C.S.I., I.C.S., Financial Commissioner, Punjab.
(3) The Hon'ble Lieutenant-Colonel P. R. T. Gurdon, C.S.I., I.A., Commissioner, Assam Valley Districts, Assam.
(4) The Hon'ble Mr. H. Thompson, C.S.I., I.C.S., Financial Commissioner, Burma.

Scope of enquiry.

In conducting our enquiries and even more so in drafting our report, we found it impossible to treat at length all the very numerous questions involved; and we were compelled to dismiss somewhat briefly many subjects of importance, in order to avoid loading our report with a mass of detail which would have delayed its issue very seriously, while not adding materially to its practical usefulness.

Moreover, although much information of technical and industrial value will be found in the evidence of some of the expert witnesses, our report is not intended as an industrial survey of India, and we have, therefore, concentrated our attention on the machinery which we propose should be set up to effect industrial development generally, rather than on the particular industries to be improved. This machinery will, we believe, do what is needed for all industries, and it would be useless for us to attempt to frame detailed recommendations for which technical enquiries by experts are required. We have carefully studied the position of certain important industries and the proposals which have been made for their improvement; but we have used the knowledge so obtained as a basis for our recommendations for the technical and administrative equipment which Government will require and for the financial facilities it should provide. In a few cases, however, when we deemed an industry of sufficient importance to deserve special treatment, we have had notes prepared in greater detail: these will be found as appendices. We have dealt at length with the important questions of the organisation of the scientific and administrative services, with technical education and industrial finance; and have, we hope, worked out a scheme which will enable Government to keep in touch with, and assist, industries of all classes, whether domestic or organised. But the reader must not expect to find in this report the practical information which would enable a particular undertaking to be started; such, for instance, as would be furnished by an expert when reporting on the prospects of a proposed industry. Still less must he regard it as an industrial *vade mecum* to guide him by short cuts to fortune. Even had we attempted to describe the general principles determining the success or failure of any particular industry, this would still be of no use to the would-be industrialist, without knowledge of local details regarding the supplies of raw material, the markets for the finished article, and the cost of labour, information which it would be impossible to give in a report of this nature. We hope, however, that in the imperial and provincial Departments of Industries, when in working order, will be found an organisation for collecting such information.

Effect of the war on public opinion regarding industrial matters.

We feel it necessary to refer to the considerable change in public opinion regarding industrial questions brought about by the war, a change which we also see reflected clearly in the policy of Government. We have explained in our report the deadening effect produced by Lord Morley's dictum of 1910 on the initial attempts made by Government for the improvement of industries; but a change of sentiment was gradually coming about, and a considerable step in advance was marked by the appointment of our Commission, with liberty to discuss the question of the direct participation of Government in the industrial development of the country. Since then, the views of Government and of the public have been further modified under the stress of war necessities, which have led to a still more definite adoption of the policy of State participation in industrial development, and to the grant of State assistance to several industrial undertakings, of which the scope is not in every case limited by the possible duration of the present war. The working of the Indian Munitions Board has shown several examples of this policy, and we trust that care will be taken to preserve such features of this organisation as are properly adaptable to peace conditions. We desire here to refer to the extent to which the action taken by Government and private industrialists under conditions created by the war has assisted us, by furnishing actual examples of schemes which we had been contemplating; though some of our conclusions have thus been forestalled, we have been enabled to present them with more certainty and completeness. Finally, we may claim that the public discussions called forth by the activities of our Commission and the evidence taken by it have also borne their part in this movement, and have led to proposals being put forward or action being taken by Local Governments for the improvement of technical education, the employment of experts, the creation of official organisations, and assistance to individual industries, which clearly evidence the widespread desire for progress in the direction indicated in our report.

Acknowledgements of assistance.

It is our pleasant duty gratefully to acknowledge the generous assistance and hospitality which we received from officials and non-officials throughout the course of our work. We wish in particular to record our sense of the help which we received from representatives of the numerous industrial firms to whom we applied for advice and information. We derived much encouragement from their readiness to place at our disposal the results of their valuable experience. We desire also to express our thanks to the Local Governments and Administrations for their cordial co-operation in our enquiries.

We have now only to place on record our appreciation of the services of Mr. R. D. Bell, I.C.S., our Secretary, and of Mr. G. H. W. Davies, I.C.S., who joined us as Joint Secretary in October 1917. The former rendered valuable assistance in working out the detailed lines on which we subsequently conducted our work; and his service with the Indian Munitions Board gave him most useful experience which was freely placed at our disposal. Mr. Davies, who had previously acted as Secretary to the Bengal Provincial Industries Committee, lightened our labours materially by his willing help.

CHAPTER I.

RURAL INDIA, PAST AND PRESENT.

Relative industrial backwardness of India: its causes.

1. At a time when the west of Europe, the birthplace of the modern industrial system, was inhabited by uncivilised tribes, India was famous for the wealth of her rulers and for the high artistic skill of her craftsmen. And, even at a much later period, when merchant adventurers from the West made their first appearance in India, the industrial development of this country was, at any rate, not inferior to that of the more advanced European nations. In both, industries had for long been protected and controlled by somewhat similar systems, the gilds of Europe fulfilling in this respect much the same functions as the Indian castes. But the widely different social and political conditions of the West had helped the middle class to establish itself on a foundation of commercial prosperity, and the struggles for political and religious liberty in which it had taken its share had endowed it with a spirit of enquiry and enterprise, that was gradually and increasingly directed to the attainment of industrial efficiency. It was to this middle class, that the so-called "industrial revolution" of the eighteenth century was mostly due. This revolution was only the culmination of a long series of attempts to utilise in the most profitable way the natural resources available. But even at this time progress was by the slow methods of "trial and error", and the knowledge of scientific laws was in an elementary stage throughout the period when the most striking industrial advances were being made.

2. The East India Company, whose agents first set foot in India at a time when the earliest beginnings of the great industrial movement were making their appearance in the west, was primarily a trading corporation, whose rôle was to exchange as far as possible the manufactured goods of England for the products of India. Whether these products were raw or manufactured was not a matter of vital importance to the success of its trading operations, which was not seriously affected by the exclusion at one time of Indian silk and cotton goods, brought about by the jealousy of British manufacturers. Attempts were frequently made throughout the period of its domination, and even subsequently, to introduce into India various manufactures with State support and encouragement; but in the absence of scientific knowledge, such experts as were then available were unable successfully to adapt the results of western experience to Indian conditions, and most of the enterprises ended in failure, perhaps the best-known instance being the iron works of southern India. These failures strengthened the erroneous idea that tropical countries, with their naturally fertile lands and trying climate, were suited to the production of raw materials rather than to manufactures. The growing success of the textile industry did little at first to dispel this view, and, as the doctrine of *laissez-faire* established itself, gave further force to the theory that Government was ill-qualified to further industrial development by direct action, and that all such matters should be left to private enterprise. The efforts of the State were concentrated on the improvement of communications and on facilitating the flow of trade, which continued, under the conditions above described, to consist mainly of exports of Indian raw material and imports of foreign manufactured products. But the feeling which gradually

arose among thoughtful men in India, that the existing conditions were unsatisfactory and were even inimical to national development, was well founded; and, accentuated by the growing pressure of foreign competition, and latterly by the stress of a terrible war, has culminated in a universal demand for a complete industrial system on western lines.

A more detailed account, however, of the economic position is necessary for a clear understanding of the complex factors which must be taken into account before framing a remedial policy.

India before railways.

3. The coming of the railway and the steamship, the opening of the Suez Canal, and the extension of peace and security by the growth of the British power have brought about very great changes. In earlier times every village not only grew most of its food, but either provided from its own resources or obtained from close at hand its few simple wants. Its cloth, and often the raw material for it, its sugar, its dyes, its oil for food or lighting, its household vessels, and agricultural implements, were manufactured or produced either by the cultivator himself, or by the village craftsmen, who were members of the village community and were remunerated by a share of its produce. Money for the payment of the Government dues and for the purchase of metals or of luxuries was found by the sale of surplus food-grains or of agricultural and forest products required by neighbouring villages. These exchanges were effected and financed by the country traders, who were found mostly at the large villages or small towns that formed the centres of a series of economic circles, the radius of each of which was measured by the distance to which the few local imports and exports could be profitably carried.

The above is a fair description of the country as a whole; but there were not wanting other and larger centres of trade, situated on the few recognised routes of land transport, on navigable rivers, or on the sea-coast, where a market existed for the articles to which their rarity or costliness lent sufficient value to offset the expense of carriage from a distance. These were few, for communications were difficult and insecure. Precious metals, artistic manufactures, and a few rare drugs and dyes made up the bulk of this traffic, which was mainly directed to the ports from which trade with foreign countries was carried on, or to military and administrative centres. The courts of Indian rulers had always attracted to themselves the surplus grain of the countryside to feed the armies, officers, and dependents of the Chief. These, and the traders and artificers who supplied their needs, made up the population of an old Indian capital. From an industrial point of view, the most interesting section of this population was the class of artisans who were engaged in producing not only arms and leather accoutrements, but rich textile fabrics, carved stone, wood and ivory, wrought metal, jewellery, and other articles of luxury, often of exquisite workmanship and high artistic value. Even to-day, the famous centres for the production of Indian artwares are the old capital towns. The earnings and social position of such craftsmen were, in times gone by, out of all proportion to those of the less skilled workers in the villages or small towns.

4. The ports were hardly less numerous, though far smaller than to-day; it will be clear from the account already given, that their trade was only in the rarer and more valuable articles and in commodities such as spices, of which India possessed a complete or partial monopoly. It was further restricted in the case of the western ports by the formidable barrier of the Ghats, with the result that all but the most portable and valuable exports were drawn from the comparatively small area between them and the sea. The foreign traders who

were settled at these ports, with a few agencies located along the various trade routes which supplied them, not only collected these articles, but took an increasing share in the finance and organisation of their production.

We have now to see in what ways this state of affairs has been modified by outside influences.

Effect of Exports.

Economic changes in rural areas.

5. Turning in the first place to the rural areas, we find an increasing degree of local specialisation in particular crops, especially in those grown for export. Cotton is now no longer planted in small patches in almost every village where conditions are not absolutely prohibitive, but is concentrated in areas which are specially adapted to its various types. The dry plains of central and western India are admirably suited to a short-stapled but prolific kind; while the canal-fed zones of the Punjab, the United Provinces, and Sind are producing an increasing quantity of longer-stapled types, which are also grown in the retentive soil and moister climate of Gujerat and in the well-irrigated areas in Madras. The peculiarly favourable climate of Bengal has tempted the ryots to extend their jute cultivation, often at the expense of their foodstuffs, while sugarcane is disappearing from tracts not specially suited for it. A visible sign of this movement may be seen in the abandoned stone cane mills lying near villages in the arid plains of Central India, which now prefer to keep their scanty stores of water for other crops and pay for their sugar by the sale of their cotton. The people have been led to make this change by the cheap railway and steamer transport and by the construction of roads, which, while facilitating the introduction of foreign imports, also render available to the farmer in his distant and land-locked village a large share of the price offered by far-off nations for articles which once merely supplied the needs of Indian rural life. Markets have sprung up on or near the railway, where the foreign exporters or the larger Indian collecting firms have their agencies; and the ryot is now not far behindhand in his knowledge of the fluctuations in the world-prices of the principal crops which he grows.

Improved means of communications have had another important effect in altering the nature of the famines to which so large a part of India is exposed, and in lessening their disastrous results. The development of irrigation and the improvement of agriculture enable the country in a normal year to grow a much larger quantity of foodstuffs than before, and it is now possible, thanks to the railways, to divert supplies from the export trade to the famine-stricken tracts. Famine now connotes not so much a scarcity or entire absence of food, as high prices and a lack of employment in the affected areas. The terrible calamities which from time to time depopulated wide stretches of country need no longer be feared. The problem of relief has been scientifically studied, and a system worked out which can be put into operation as soon as the recognised signals of approaching distress are apparent. Failure of the rains must always mean privation and hardship, but no longer necessarily wholesale starvation and loss of life.

It is clear that, if the basis of employment also be widened, crop failures will lose much of the severity of their effects, and the extension of industries, in as great a variety as circumstances will permit, will do more than anything to secure the economic stability of the labouring classes.

Scarcity of capital for agriculture.

6. The capital in the hands of country traders has proved insufficient to finance the ordinary movements of the crops, and the seasonal calls for accommodation from the main financial centres are constantly increasing. This lack

of available capital is one cause of the high rates that the ryot has to pay for the ready money which he needs to buy seed and to meet the expenses of cultivation. On the other hand, money is largely invested in the purchase of landed property, the price of which has risen to very high figures in many parts of the country. Proprietors freely spend their savings from current income on the improvement of land in their own cultivation, but loans from private persons for this purpose are obtainable as a rule only on terms quite disproportionate to the value of the improvements. These are also almost invariably made on land in the investor's own possession, not in that of his tenants. The magnificent irrigation systems of India, the drainage works of Bengal, and the relatively small amount that has been advanced by Government as improvement loans are almost the only instances where public funds have been definitely devoted to this end. The demand for capital for land improvement has hitherto perhaps been modest; but the stimulus afforded by the various provincial Agricultural and Industrial Departments, especially in Madras, has led to the introduction on a small, but rapidly increasing, scale of modern appliances to replace labour, improve cultivation, or supply irrigation water. Towards the provision of working capital for cultivation, something has been done by the co-operative movement, initiated and fostered throughout by Government action, and far more may be hoped from it in the future. But the no less urgent necessity of relieving the ryot from the enormous load of debt, with which he has been burdened by the dearness of agricultural capital, the necessity of meeting periodic demands for rent, and his social habits, has hitherto been met only to a very small extent by co-operative organisation.

Labour and wages in rural India.

7. It is impossible to pass from this brief sketch of the agricultural position without some allusion to the rise in the rate of wages and the growing scarcity of labour in most parts of the country. The rise in the cost of labour is due mainly to the increased demand, but in some places to the decline in the labouring population consequent on the ravages of plague during the past twenty years and on famine in the last decade of the nineteenth century, although we do not forget that the population as a whole increased by some twenty millions between 1901 and 1911. This period of distress was followed by a sequence of more favourable seasons combined with higher world-prices. This prosperity in its turn led to greater expenditure by Government, railway companies, and private enterprise, necessitating increased employment. Simultaneously, the increase in world-prices, which became effective in India owing to the rapid extension of communications, brought the cultivator more money, and the consequent rise in the cost of living furnished an additional argument to the labourer in his claim for higher wages. This rise tells heavily on those sections of the population which are not benefited by the increased agricultural and industrial production, and has accentuated the tendency of the village artisan to migrate to the towns, where better pay is obtainable.

Middlemen and the export trade.

8. The export trade from country districts generally suffers from the existence of an undue number of middlemen, who intercept a large share of the profits. The reasons for this are various. In the first place, it must be remembered that a great number of Indian cultivators are indebted to a class of traders who not only lend money, but lend, purchase, and sell grain, and sell such articles as cloth, salt, and oil to small consumers. The position of a peasant farmer, with grain, seeds, or cotton to sell, and at the same time heavily indebted to his only possible purchaser, effectually prevents him from obtaining a fair market price for his crop. Even where the farmer is not burdened by debt, his business with the dealer is still very often on a *per contra* basis, his purchases and sales being alike reckoned in cash in the dealer's books, at a rate which

is not always known to the customer at the time. The farmer, owing partly to poverty and partly to the extreme subdivision of land, is very often a producer on so small a scale that it is practically impossible for him to take his crop to the larger markets, where he can sell at current market rates to the agents of the bigger firms. This is especially the case in Bengal, Bihar and Orissa, and the United Provinces. Here most of the articles of export are purchased from local dealers by the exporting agencies. The larger markets are usually frequented by an unnecessary number of brokers and touts; and there are almost always one or more intermediaries between the purchaser who moves the grain to the point of consumption or export, and the producer or other person who actually brings the crop into the market. The market rules and organisation do not usually provide means for preventing or punishing fraudulent trade methods; while the multiplicity of the local weights and measures, and, in many cases, it must be added, the natural desire of the seller not to be the only person defrauded, contribute still further to an undesirable state of affairs. Complaints are frequent, but all parties accept what appears to them the inevitable. But, where a better organisation has been established, the ryots thoroughly appreciate the benefit. A better market system, co-operative selling, and education are the most promising remedies.

Effect of Imports.

Influence of imports on village life.

9. Such are some of the far-reaching effects on country life of the increased flow of exports from India. The greater number and variety of imports have also had their influence, though in a less marked degree. Vessels and implements of iron, brass, and copper are now commonly used in the villages, and their price is within the reach of almost all classes. Petty articles of domestic use or personal ornament, such as scissors, mirrors, bangles, and the thousand and one cheap and glittering trifles with which the rural huckster decks his stall, have poured in from abroad. Drugs and patent medicines of all kinds, Indian and foreign, command a ready sale. Sewing machines are found nearly everywhere, and bicycles are in ever-increasing demand.

The effect on small industries in India has been considerable, but has not always been in the same direction. The import of brass sheets, for example, has reduced the demand for the services of the brass founder, but has greatly extended the business of the maker of brass hollow-ware. Cheaper iron obtainable in convenient sections has helped the cultivator to buy more and better carts, and has diminished the cost of many of his indigenous implements. The position of the village artisans is changing. The tendency is for them to lose their status as village servants, paid by the dues of the village community, and to become more and more ordinary artisans, who compete freely among themselves for custom; in some cases, notably that of the village leather worker, they are disappearing under the competition of organised industries. The influx of mill-made piece-goods, not only of foreign, but of Indian manufacture, had before the war cheapened the price of cloth in comparison with other commodities and had enormously extended its use by the poorer classes, but had, at the same time, prejudicially affected the communities of weavers scattered over the country in the towns and larger villages. In India a far greater degree of resistance has been offered by the hand loom to the aggressions of the factory than in England. This is attributable to the great number of specialised types of cloth of which slow-moving Indian custom decrees the use; to the fact that the demand for many of these is on so small a scale, while the types themselves are so special, as to render it difficult for the power loom to produce them at a profit; to the faithfulness of the weavers as a caste of their hereditary trade, and their unwillingness, especially in the smaller towns, to take up factory work; and to a less extent, to the money locked up, on a vicious system it is true, in the financing of the weaver by his patron and incubus, the money-lending cloth merchant.

Standard of comfort affected by imports.

10. The effect of the use of imported and factory-made articles on the standard of comfort of the rural population has been, however, generally small. The poverty of the Indian peasant precludes most novel forms of expenditure, while lack of education and the prescriptions of custom make him slow to accept any innovations in his food or clothing, or in the habits of his daily life. But the enormously extended use of cotton cloth, especially of the finer counts, of woollen clothing, the introduction of kerosene oil, matches, collapsible umbrellas, and of better and cheaper cutlery and soap, have added appreciably to the comfort of the people.

The increase of exports and imports has facilitated the provision of funds for communications. The existence of these communications has itself had an educative effect on the people, has gradually helped to render labour more fluid and incidentally more costly, and has added to the sense of political unity among the more educated classes.

This rough sketch may serve to illustrate the effect of modern industrial and commercial development on the rural areas which furnish most of the raw material of Indian trade and industry and, so far, almost all the markets for the latter; and we may now turn to a study of some of the principal centres of industry where its progress is most readily discernible.

CHAPTER II.

SOME INDUSTRIAL CENTRES AND DISTRICTS.

Diversity of conditions in different parts of India.

11. The great dissimilarities of soil and climate and the diverse causes which have affected the development of the various parts of India are responsible for wide and striking inequalities of economic conditions. The stony, arid Deccan uplands, where the precarious rainfall will scarcely allow the thrifty Maratha farmer to hope for a good harvest even in one year out of two, afford a marked contrast to the rich alluvial plains of Bengal, a land that has little to fear from the seasons but occasional floods. The canal zones of the Punjab, with their secure crops of wheat and oil seeds, are intermixed with the desert plains of the *barh*, that yield hardly more than a scanty pasturage for camels or cattle. Only a very few miles away from large and prosperous ports or busy mining districts are wide stretches of jungle or sandy deserts. A mere general outline of the economic position in India would be of no value for the purposes of this report, while to delineate the whole picture in detail would be impracticable. The most convenient way of presenting the commercial and industrial conditions of the country, as a basis for our proposals, is by a description of selected areas or centres as specimens of economic development, in which the factors with which we have to deal appear in varying circumstances and degrees. Prominent among these are the great cities of Bombay and Calcutta; up-country manufacturing towns like Cawnpore; distributing markets like Delhi; the cotton and jute tracts, where machinery and markets have been gradually called into existence to deal with important commercial crops; the railway workshops; and the coal and iron districts of Bengal and Bihar. These are alike characterised, in a greater or less degree, by the presence of large traders and leaders of organised industry, accustomed to buy and sell or to manufacture on a wholesale scale and in close touch with the conditions of world markets and world industries; of aggregations of capital; of groups of factories and bodies of semi-skilled or unskilled labourers, who have migrated thither, temporarily or permanently, from distant places, leaving the homes and small farms which they often still possess to the care of their families or relatives; and of larger or smaller engineering works, which have sprung up to supply the needs of organised industries and require the services of skilled mechanical engineers and artisans.

The large agency firms.

12. A characteristic feature of organised industry and commerce in all the chief Indian centres is the presence of the large agency firms, which, except in the case of Bombay, are mainly European. In addition to participating in the export and import trade, they finance and manage industrial ventures all over the country and often have several branches in the large towns. The importance of these agency houses may be gauged from the fact that they control the majority of the cotton, jute and other mills, as well as of the tea gardens and the coal mines. This system originated and has still continued owing to the ability of these houses to furnish financial help to industries; it also owes its existence to some extent to the difficulty, in the case of companies under European control, of finding among the relatively small class of leading men of business available in India directors, especially managing directors, who will remain in the country long enough to guarantee the continuous supervision requisite for the successful conduct of such businesses. An agency

firm as a rule comprises several partners, some of whom are taking their turn of duty in India, while the others attend to the firm's affairs in London or elsewhere. There is no doubt but that the system is in many ways well adapted to present conditions in India, and has a far greater list of successes to its credit than can be shown by ordinary company management under individual managing directors. We are much impressed by the strong evidence of the high financial prestige possessed by the better-class agency firms, and of the readiness of the investing public to follow their lead, a position only reached, we recognise, by a policy, extending over many years, of efficient management, cautious finance and watchful attention to the interests of client enterprises. Nevertheless, they have not escaped criticism as being unduly conservative in their methods of business and as exhibiting undue reluctance to embark on new ventures. They have been charged with lack of enterprise and an unwillingness to follow up lines of development naturally proceeding from the expansion of operations in their own specialised industries. In other words, they have been inclined to develope commerce rather than industries, and have thus been at times less helpful than might have been the case, in clearing the way for continuous industrial progress.

In recent years, however, a new spirit has arisen, evoked by the genius of a few men who have boldly faced the industrial needs of India and have not been deterred by the large scale on which it is necessary to start operations. They have instituted such thorough preliminary enquiries that they have been able to accept the conclusions reached with confidence and, when these were favourable, to act upon them. The success which they have achieved as a result of the scientific methods adopted has encouraged others to similar efforts, and these have been further stimulated by the war, which has clearly demonstrated the vital necessity for industrial development and has, temporarily at least, lessened foreign competition.

Calcutta.

13. The large centres are not numerous, and are of such importance to the surrounding districts and so decidedly differentiated from them as to warrant a more detailed and individual description.

Calcutta, in spite of the position and consequent expense of the port, 120 miles from the open sea and on a dangerous river, has immense natural advantages in its situation on the estuary of the mighty river system which traverses the fertile and populous plains of Bengal, and in the fact that it is the undisputed centre of the great jute, tea and coal industries.

The jute industry.

14. Jute was apparently first shipped from Bengal in 1795 by officers of the East India Company seeking an Indian substitute for hemp, but it was not until 40 years later that pure jute yarn was made and sold in Dundee. Subsequent exports of the raw material grew rapidly, especially during the Crimean and the American Civil wars, when supplies of Russian flax and hemp and of American cotton respectively were cut off from the European markets, until in 1908-09 they totalled 893,955 tons; thereafter they have shown some tendency to decrease. In Bengal the hand-loom industry assumed considerable proportions in the first half of the 19th century, and, as late as 1850, the value of the manufactures exported exceeded that of the raw jute; but it was not until 1855 that the first machine-spinning mill was erected at Rishra near Serampore, followed after four years by the first power-loom factory at Barnagore just outside Calcutta. In 1881, 5,000 power looms were at work

in Bengal; in 1891, 8,000; in 1901, 16,000; and in 1911, 33,000 in 59 mills, while the latest figures available (1916-17) show 71 mills running with 39,404 looms and employing 260,199 persons. The paid-up capital of these concerns, including debentures but excluding reserves, amounts to 13¼ crores of rupees and 2¼ million pounds sterling; and the mills now manufacture over 1,000,000 tons of the raw material annually. Jute manufactures exported in 1913-14* reached a total value of 28¼ crores of rupees for all India, while in the same year exports of raw and manufactured jute together were valued at 59 crores, or almost 25 per cent. of the total exports of Indian merchandise. Including India's internal consumption of jute manufactures, the annual average value of the jute trade to Bengal has been computed at 60 crores of rupees, or £40,000,000 sterling at the pre-war rate of exchange. The association of the Calcutta jute industry with the east coast of Scotland has throughout remained intimate. The majority of the European staffs are of Dundee extraction, and most of the experts in the managing firms are Scottish. A few jute mills are driven by electric power generated from coal, and the plant is usually of an up-to-date type and maintained at a level of efficiency which is relatively high for India. The average jute mill is generally, it must be remembered, on a larger scale than the average cotton mill.

Labour in the jute mills.

15. The mills draw their labour mainly from Bihar and Orissa, the United Provinces, the northern districts of Madras, and Bengal. The Bengali is taking a smaller and smaller share in the openings for manual labour created by the mills. Some interesting proofs of this tendency are cited in a note placed before us in Calcutta, from which we take the following particulars. In a Government report on labour in Bengal (1906), it is stated that 20 years earlier all the hands in jute mills were Bengalis, but that at the date of the report two-thirds of them were immigrants. At the present time about 90 per cent. of the labour is imported. A census was taken in 1902 by the managing agents of four mills in Garulia, Bhadreswar and Titaghur. Another census was taken by the same managing agents in the same areas in 1916, the mills having meantime increased to seven. The result showed 28 per cent. of Bengali workers in 1902, and 10 per cent. only in 1916. The shortage had been supplied from the Northern Circars. It is significant that there were 350,000 more immigrants in 1911 than in 1901 in Calcutta, the 24-Parganas, Howrah and Hooghly. In the 24-Parganas in particular, the number of immigrants had increased by 176,000, or nearly 80 per cent.

The mill workers are in almost all cases recruited by and employed under a class of men known as *sardars,* usually themselves of similar origin to the labour they supply. Some mill-owners complained to us of this system, which is an obstacle to progressive management, and does not conduce to industrial peace; but they professed their inability to alter matters. The labourers live as a rule in what are known as *bustis,* collections of huts in the neighbourhood of the mills, which are neither owned nor leased as a rule by the mill management, but are often the property of the *sardars.* This last is an eminently undesirable practice. In these *bustis* the workers are poorly housed among surroundings usually insanitary and unpleasant, though praiseworthy efforts to improve matters have been and are being made on an increasingly large scale by mill-owners, who have erected dwellings on or near the mill premises for a proportion of their labourers. The latter are ready enough to avail themselves of the accommodation provided. The position of mill labour in general and the housing question in particular, form the subject of Chapter

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* We have taken the latest figures available, except in cases where obviously the figures are seriously affected by war conditions; *e.g.*, exports and imports, and in some cases railway transport.

XVI. Specimen wages of jute-mill operatives in June 1918 are exhibited in the statement below. The figures are in rupees per mensem :—

Carders.	Rovers.	Spinners.	Shifters.	Winders.	Beamers.	Weavers.	Mistries.	Coolies.
9	12	14¾	11	18	22	27	30	13

Wages are paid weekly, one week in arrears.

Mill-owners complain of the unwillingness of their labourers to respond to the stimulus of higher wages; the latter do not as a rule increase their output when engaged on piece-work, but merely work fewer days in the week. The reasons for this were investigated in some detail by us. We have little doubt but that the long hours passed in the uncongenial, if not unhealthy, surroundings of a factory, from which the labourer returns at night to a dirty, crowded and insanitary hovel, where his only relaxations are found in the liquor shop and the bazaar, are most unattractive to a man accustomed to rural life, and it is only the congestion existing in his native district and the desire to earn higher wages for a time, that lead him to submit to such conditions. The mill workers of Bombay and Calcutta do not for the most part remain permanently at the mills, but return after a longer or shorter period to their native villages, though they eventually drift back in many cases to the mills. This practice affords a much needed change from the conditions under which the labour force lives and works, conditions which can never create a skilled and steady class of operatives. The labourers are, moreover, almost entirely uneducated; the facilities for the education of their children in the villages from which they come are, it is believed, quite inadequate; whilst in the neighbourhood of the mills, for children who are taking their share in mill labour, they exist only in the few cases where they have been provided by enlightened employers. More will be said in a later chapter regarding the problem of the education of juvenile factory workers; it is sufficient here to point out that, without education, a standard of comfort that will respond to the stimulus of decent housing and lead to a desire for increased earnings is not likely to be attained.

Share taken by Indians in the jute industry.

16. It is a noteworthy fact that Bengali, or indeed Indian, capitalists have taken very little part, otherwise than as mere investors, in the starting, and none at all in the management of jute mills. The step from trading in and financing cotton to its actual manufacture was readily taken, with the help of English textile experts, in Bombay, where the weaving of the local staple by hand was a prominent industry before the import of mill-made goods. Similarly in Bengal the weaving of jute fabrics was an important industry in the first half of the last century and, until very recently, the initial collection and finance of jute were mainly in Bengali hands; but in Calcutta the Bengali merchant, who had settled there to take his share in general trade, was apparently unable to pass on from that stage to manufacture and, even in his commercial business up country, he is yielding ground to the more enterprising Marwari trader from Rajputana.

There is another reason which may perhaps have contributed to this failure on the part of the Bengali to take advantage of his position. British capital and expert skill have been freely poured into the Calcutta jute industry owing to the advantages of its location, while, for almost 40 years past, the industry in the United Kingdom has stood still, in point at least of the quantity of jute consumed.

Engineering firms and miscellaneous factories.

17. The existence of jute mills, of tea and jute cultivation in Assam and Bengal, of busy river traffic and a great port, and the neighbourhood, in more recent years, of coal mines, have led to the establishment of engineering firms,

some of considerable size, in or near Calcutta, the number of which in 1915 was stated to be 27, with 12,000 employés.

There are also in and round Calcutta various miscellaneous factories, the most important being the flour and paper mills, the labour supply of which is recruited and organised on the same basis as that of the jute mills. A noteworthy feature of Calcutta industrial life, which has become much more prominent in recent years, is the number of small organised industries recently taken up by Indians, such as tanning, pottery and pencil making ; also the many small power factories for oil milling and rice husking owned by them. The rapid increase in the number of these latter leads to the belief that they earn a profit, though the condition of their plant usually leaves a good deal to be desired in point of efficiency.

Sea-borne and inland trade.

18. The sea trade of Calcutta in normal times is carried by certain regular lines, and by a number of tramp steamers and a few sailing ships. The number of vessels entered and cleared from the port of Calcutta in the year 1913-14 was 999, of 3,077,199 tons burden. The figures for imports and exports of private merchandise in the same year were (in thousands of rupees) :—

	Chief heads.	Value.
Imports.	Cotton manufactures	28,87,14
	Twist and yarn	95,44
	Metals and ores	9,66,17
	Sugar	6,46,73
	Machinery and mill work	3,20,64
	Oils	2,05,66
	Hardware	1,42,31
	Total under all heads	74,49,52

	Chief heads.	Value.
Exports.	Jute manufactures	28,20,24
	Jute, raw	28,03,44
	Tea	10,55,75
	Hides and skins	8,47,59
	Grain, pulse and flour	6,85,60
	Seeds	3,59,07
	Total under all heads	98,50,27

A vast amount of traffic passes down the Hooghly by river steamer and country boat : the two principal river steamship companies own 204 steamers and 313 flats. The total merchandise thus brought into Calcutta in 1913-14 was 1,126,000 tons, the leading lines of goods being raw jute 334,000 tons, gunnies 188,000 tons, and rice and paddy 198,000 tons. The Eastern Bengal and the Assam Bengal Railways share with the river craft the trade of the fertile and densely populated jute and rice districts of northern and eastern Bengal. The Bengal-Nagpur Railway traffic consists mostly of coal and of seeds and food-grains from Orissa and the Central Provinces. The East Indian Railway, which is the largest system of the three that terminate in Calcutta, imports food-grains and seeds from northern India and south Bihar, and handles the bulk of the coal traffic. The total volume of the rail-borne trade of Calcutta in 1913-14 reached 10,389,000 tons, of which imports amounted to 8,605,000 and exports to 1,784,000 tons.

A large share of this trade is in the hands of a class of Indian, mainly Marwari, merchants, who as a rule have not hitherto directly handled oversea imports (except piece-goods, cheap iron and galvanised sheeting) or exports, but have carried on their trade in import and export goods through European houses. These latter export country produce and manufactures, the greater proportion of which is, however, in the case of the largest firms, purchased by their own agents up country, and import piece-goods, metals, machinery, sugar, etc. The export trade here, as in other large Indian ports, is financed by the exchange banks, who purchase the bills which exporters draw on consignees or their bankers or agents in other countries, and to a certain extent by large importers direct.

Bombay.

Trade and communications.

19. The city of Bombay owes its origin to its geographical position and to its magnificent harbour, which gradually became a collecting centre for other ports on the west coast and for the relatively small strip of land between the Ghats and the sea. During the closing years of the Maratha power, the contrast afforded by the peace and security of Bombay with the disturbed Deccan was responsible for a great addition to the wealth and population of the city. The introduction of a more settled rule in the country above the Ghats was almost immediately followed by the making of a road over the Bhor Ghat to Poona. From that time progress in communications between Bombay and the country to the north and east has been continuous; and it is now connected with Gujerat and northern India by the Bombay, Baroda and Central India Railway, and with the Deccan, Central India, the Gangetic plain, Calcutta and Madras by the Great Indian Peninsula Railway. Bombay thus receives a large quantity of country products of all kinds, of which by far the most important is cotton; it lacks the advantages which Calcutta possesses in its proximity to the coal fields and in the river system of Bengal, though its harbour opens directly on the sea and affords greater possibilities of improvement, of which full advantage is being taken. The traffic in and out of Bombay over the railways in 1913-14 was (in thousands of tons):—

Inward	3,230
Outward	1,642

Amongst the principal items were (in thousands of tons):—

Imports.		Exports.	
Raw cotton	520	Cotton manufactures	98
Oil seeds	904	Metals and machinery	229
Wheat and flour	324	Sugar	155

The cotton industry.

20. The principal industry of Bombay is the spinning and weaving of cotton, of which, however, it possesses by no means the monopoly which Calcutta can claim in the case of jute manufacture. An account of the origin of the Bombay cotton industry will be found in Chapter VII. In the year 1916 there were 266 mills in India, containing 6,839,877 spindles and 110,268 looms and employing an average number of 274,361 hands daily; of these Bombay itself possessed 86 mills, 2,984,575 spindles and 53,205 looms, and the persons employed numbered 118,303. Cotton spinning and weaving, though India's share in the industry is mainly confined to the lower counts, require finer manipulation than the process of jute manufacture, and demand more skill on the part of the operatives. Though the first Indian cotton mill was opened in Calcutta and other attempts have been made since to establish a cotton industry there, these, with few exceptions, have been far from successful. Calcutta is no doubt less favourably situated in respect of the cotton tracts generally than Bombay, although much of the cotton consumed by the latter reaches it from places as distant as those from which Calcutta draws its supplies, while Bombay is at a disadvantage in respect of fuel, a deficiency now to some extent supplemented by water power.

Labour in the cotton mills.

21. The Bombay mill operative, whether owing to his training or not, is more skilful and intelligent than the Bihari immigrant into Calcutta, though probably no better educated, while he is more tolerant of uncomfortable surroundings than the Bengali labourers, who possess a relatively high degree of intelligence. The wages of mill labour are higher in Bombay than in Calcutta and have been raised appreciably since 1914. Sample rates, including a war bonus, for Bombay in the year 1918 were (in rupees and annas per mensem) :—

	Rs.	As.
Drawer (cardroom)	23	6
Reeler	17	4
Warper	40	8
Rover	24	1
Doffer (cardroom)	12	10
Weaver	46	15

Although wages are higher in Bombay, local conditions, so far as they affect the housing of labour, are more difficult in the island of Bombay than round Calcutta. The Calcutta mills are spread out over a long stretch of land on both banks of the river, and the labourers live, as we have seen, in *bustis*, or collections of single-storeyed huts. Owing to the lack of space in Bombay, the mill hands live in chawls, buildings several storeys high divided into a number of single-room units, which are too often overcrowded. This congestion has intensified the effects of plague, an ever-recurring factor in the problem of the industrial labour supply.

The labourers consist mostly of Marathas from the Deccan and Konkan, a small section of Konkani Mahomedans and Julhais (the Mahomedan weaver caste), with a few men from Central India. The first two classes are usually cultivators of holdings too small to afford them a subsistence, and heavily indebted to the village money-lender. This habit of indebtedness adheres to them in Bombay, where they, in common with other mill hands, are usually deeply in the books of petty money-lenders. The few mill hands from Central India and the Julhais are far more careful with their money and work harder. The former indeed are rarely in debt and occasionally even lend to their weaker brethren. There is more specialisation in different departments of the mill by workers of particular castes or origin than in Calcutta. The mill hands are recruited by and employed through a class of men known as jobbers, and are paid monthly, one month in arrears.

These remarks do not apply to the handling of goods for export and import, and the work at the docks, which require labourers of a different type.

Other industries.

22. Among the main industries of Bombay, other than the cotton mills, are the engineering shops, which have sprung up here for the same reasons as at Calcutta, though they are less extensive and numerous. The more important concerns numbered 12 in the year 1915, the largest of which employed over 800 hands. There were in addition two silk mills, four flour mills, and a considerable group of tanneries producing half-tanned leather, with one large tannery and leather factory employing about 500 hands.

The disadvantage under which Bombay for so long laboured, owing to its distance from the coal fields, has recently been largely reduced by the facilities which the proximity of the Western Ghats affords for the generation of hydro-electric power. This has been utilised by the enterprise of a great Bombay firm, whose hydro-electric works at Lonavla produce 42,000 horse power and deliver it at a charge of ·5 annas per unit, where motors are supplied by the mills, and ·55 annas, where they are found by the hydro-electric company. Other schemes on an even larger scale are under construction and in contemplation.

Sea trade.

23. The sea trade of Bombay, in addition to ordinary country produce, consists mainly of the export of raw cotton and of locally manufactured yarn and piece-goods, and the import of foreign piece-goods and yarn, sugar, metals, machinery and miscellaneous articles. The figures of imports into and exports from Bombay by sea in 1913-14 under the leading heads for trade were as under (in thousands of rupees):—

	Chief heads.	Value.
Imports.	Cotton manufactures	16,51,50
	Cotton twist and yarn	1,49,53
	Silk manufactures and yarn	2,26,05
	Wool manufactures and yarn	1,62,89
	Metals and ores	7,16,69
	Machinery and mill work	3,08,88
	Hardware	1,32,02
	Sugar	3,83,78
	Oils	1,34,35
	Total under all heads	94,18,99

	Chief heads.	Value.
Exports.	Cotton, raw	29,70,81
	Seeds	12,54,98
	Cotton twist and yarn	9,21,00
	Cotton manufactures	1,17,90
	Metals and ores	1,10,21
	Total under all heads	74,46,39

The railway connection with the docks was until recently very inconvenient, necessitating a double handling of goods; and the transport of cotton by carts to the Cotton Green at Colaba and back again to the mills or docks adds to the cost and congests the streets. Matters will be much improved when the new scheme for direct connection between the railways and docks, involving the construction of extensive storage accommodation and the transfer of the Cotton Green to the neighbourhood of the docks, has been completed.

The principal shipping lines are much the same as those of Calcutta; in addition, there are the pilgrim traffic to the Hedjaz and trade to the Persian Gulf, in which Indian firms share largely. The coasting trade with Karachi, Kathiawar, the Malabar coast and Goa is of some importance. Indian-built sailing craft participate in this and also visit the Persian Gulf and the coasts of Arabia and East Africa. In the year 1913-14 the number of ships entered and cleared from the port of Bombay was 1,536, with a tonnage of 3,837,111.

Share taken by Indians in Bombay trade.

24. The trade of Bombay is shared by Europeans, Parsees, Bhatias, Khojas and Banias. It is financed by banking agencies similar to those in Calcutta, branches of the same banks being, with few exceptions, found in both cities. The mills obtain a certain proportion of their finance in the form of deposits from the public. Bombay as a financial centre has been and is still prone to speculation, and the movements of the cotton market and of stocks and shares are always active and sometimes violent. There are, as in Calcutta, a number of firms and individuals doing exceedingly remunerative business as brokers in articles of merchandise, insurance, freight and exchange, as well as in stocks and shares.

The most noteworthy difference between the two cities is the large share taken by Indian merchants in the trade and industry of Bombay, a subject which is treated in greater detail in Chapter VII. Indians predominate in the share market, as mill-owners, and as importers of and dealers in country produce and cotton brought into Bombay from the rest of India. The foreign export and import trade is, however, still mainly in European hands, though a certain number of ships are owned by Indian firms, and Indians are also active in the freight market. The Indian element in banking is much stronger in Bombay than elsewhere; there are several banks with Indian directors; and they are also found on the Board of the Presidency Bank.

The Bengal Coal Field.

25. The coal fields of Bengal and Bihar include all the principal coal mines of India, the remainder being situated in Assam, the Central Provinces, the Hyderabad and Rewah States, the Punjab, Baluchistan and the State of Bikaner. The raisings in the Raniganj, Jharia and Giridih coal areas, which may conveniently be described as the Bengal coal field, were in the calendar year 1917, 16,563,990 tons, out of a total output for the whole of India of 18,121,918 tons. The movements from the Bengal coal field were in 1914, when trade and industry were still flowing in their ordinary channels, to Calcutta 5,353,844 tons, to Bombay 535,806 tons, and to the United Provinces 1,253,068 tons. The importance of this area to the industries of India is clear from the above figures.

The proportion of the total output of coal consumed by railways has remained almost unchanged for a number of years past and, since 1907, has not been higher than 33 or lower than 28 per cent. A more accurate census of coal consumption than in previous years was attempted in 1916. Though these figures were largely affected by the war, it is of interest to notice that 33·6 per cent. of the output was taken for railways, 16·7 for bunkers, 5·6 for jute and 5·5 for cotton mills, 5·1 for iron and brass foundries and engineering workshops, and 3·6 for inland steamers. Other heads are comparatively small, but no less than 12·6 per cent. was consumed at the collieries or wasted, and a similar quantity was taken up for use in small industries or for domestic consumption, almost entirely the former.

The Bengal coal field in 1917 was worked by 153 joint-stock companies, of which the paid-up capitalisation in shares and debentures was Rs. 672 lakhs. There were in addition many mines owned privately by syndicates and individuals.

Methods of working.

26. Coal was first mined in Raniganj for other than local requirements in 1854 when the East Indian Railway entered the Bengal coal field. The industry is at the present time by no means entirely in the hands of Europeans, though they are responsible for the working of most of the largest and best developed mines. The majority of Indian enterprises consist of small pits or inclines; where they possess pumps or winding gear, these are usually worked by small engines with vertical boilers. Such concerns are readily closed down if prices fall too low, and are as readily started again when the market improves. The technical development, however, which has been attained by the better-class mines, is a striking feature of the Bengal coal field and one of its main points of interest to students of the organised industries of India. A number of mines are now electrically operated, and two groups at least are provided with central electric generating stations, while considerable further

developments in this direction are contemplated. Sandpacking to prevent subsidence is now practised in some collieries. Mechanical screening is largely in use; aerial ropeways are working in several places; and the difficulties caused by the locking up of coal under the numerous railway sidings that traverse the various fields will, it is hoped, be solved satisfactorily before long. Coke is produced in all parts of the area, especially the so-called soft coke, about 500,000 tons of which are made per annum, as a rule by the smaller proprietors, by burning low-grade coal in heaps in the open air. Coke is also largely made by the wasteful process of burning in open-top rectangular kilns. The first by-product coke ovens were started at Giridih. There are now several other such installations on the field, producing coal tar and sulphate of ammonia, the latter with the help of imported sulphur. There are in addition a quantity of non-by-product patent ovens. It may be noted in passing that a coke, which will readily ignite and can be used in the Indian domestic fireplace, is urgently needed, and might, if a suitable cheap type of fireplace be also introduced, lead to a sensible decrease in the amount of cattle dung used as fuel, at any rate in the districts surrounding the coal fields.

The coal royalty owners are the local zemindars who under the Permanent Settlement are the owners of mineral rights. They are at present a class of mere rent chargers who take little interest in the working of their property, although great waste occurs, especially in the mines managed by the smaller interests.

The so-called first-class coal of the Bengal field rarely contains less than about 12 per cent. of ash, but it generally forms a strong coke suitable for blast furnace work, and any serious development of the metallurgical industries in this region will probably result, and that before long, in a relatively heavy attack on the visible resources. The question of encouraging and even compelling economy in mining and coking will soon be forced on the attention of the authorities.

Labour on the coal field.

27. The labour on the mines is partly drawn from neighbouring villages, partly from the more distant areas of Chota Nagpur. The average daily number of labourers employed in the Bengal coal field in 1916 was 135,093; the average daily wage per head was 7·6 annas; and the annual raisings per head of labour employed below ground were 169·4 tons.* The supply of labour is at present insufficient and intermittent; and is liable to be seriously affected by a good harvest or by an outbreak of epidemic disease, to some forms of which the coal fields have in the past been liable. Only a small proportion of the workers except in the case of one or two old-established concerns, reside permanently at the mines. The rest are usually small cultivators or agricultural labourers, who return to their villages for the cultivation and harvesting of their crops. But a new generation of workers is growing up, which can be induced to settle down as resident labour near the mines, especially if suitable accommodation be provided. Though constant efforts are being made to arrive at the ideal workman's dwelling, finality is far from having been reached, and changes of type are still frequent. The worker himself undoubtedly prefers separate huts, if possible with a small plot of garden ground. The objection to this is, of course, the expense involved, and the only area in which we saw separate huts provided on a large scale for organised labour was the Mysore gold field.

The Bengal Iron and Steel Company.

28. The Bengal Iron and Steel Company at Kulti and the Tata Iron and Steel Company at Sakchi are most important industrial enterprises in close connection with the Bengal coal field.

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*For all India.

The works of the Bengal Iron and Steel Company, unlike the Tata Company's works, have grown up gradually. They were originally started in 1875, but had a somewhat chequered history, and did not come into the hands of the present Company till about 1889. The poor quality of iron ore previously used was largely responsible for the failure of the Company to make steel at a profit in 1905 and onwards, but the managing agents, after nearly 20 years' unremitting labour, have now put the concern on a paying basis, a result to which the discovery of a body of better-grade ore greatly contributed.

The works have been extended and remodelled. They contain four blast furnaces, each with a possible output of 80 tons of pig a day. About half the coke required is made by the Company and the balance is purchased locally.

The steam is generated in boilers fired by the waste gases from the furnaces. The output of pig iron, under normal conditions, is about 10,000 tons a month. Since November 1917, one furnace has been turning out from 1,200 to 1,500 tons a month of ferro-manganese, which is exported to Europe and America for war purposes. The works contain a large foundry making pipes up to 12 inches in diameter, bends, columns, fencing sockets, pot sleepers and chairs, and are capable of producing castings up to 20 tons in weight. The Company employs about 10,000 men.

The Tata Iron and Steel Company.

29. The Tata Iron and Steel Company was formed in 1907 and commenced active operations about five years later. It owns iron mines at Gurumasini and elsewhere in India; limestone quarries at Panposh in the Gangpur State and at Khansbahal; magnesite deposits in the Mysore State; and nine large coal mines, four of which are located on the Jharia field and are now producing 55,000 tons a month. The smelting plant consists of two large blast furnaces making approximately 350 tons of iron per day each, and three more furnaces are in process of construction. Coke is at present supplied to these furnaces by 180 non-recovery Coppee coke ovens, with a capacity of 7½ tons each. The new plant under construction consists of 200 13-ton by-product recovery ovens, and a benzol recovery plant for the coke oven gases. The steel-making plant consists of four basic open-hearth furnaces of 50 tons capacity, two furnaces of 75 tons capacity and a seventh furnace in process of construction, while further extensions are now under way consisting of two 25-ton Bessemer converters, three electric furnaces, two 200-ton tilting furnaces and a mixer of 1,300 tons capacity to receive the molten metal from the blast furnaces.

The present steel capacity is nearly 17,000 tons per month. The rolling mills produce about 120,000 tons of rails and smaller sections yearly. The Government of India agreed, before the works were started, to take 20,000 tons of steel rails a year for ten years from the Company, provided they could be produced of suitable quality and at a suitable price; but, on account of the heavy demands in the eastern theatres of war, much larger quantities have been taken. The Company is now preparing to build a 96-inch plate mill. Arrangements for further extensions have also been made with a view to producing sheet steel plates and strips for the manufacture of tubes. The total developments now under contemplation will involve an expenditure of no less than 12½ crores of rupees.

About 13,000 men are now employed by the Company and 10,000 men by contractors engaged in extensions. The mines and quarries give employment to approximately 15,000 more. A town of 50,000 inhabitants has sprung up at

Sakchi, the population of which, it is expected, will be over 100,000 by the time the extensions are completed. Suitable residences for all classes of employés have been erected, including cooly lines for about 1,000 of the lowest-paid workmen. Two institutes, a primary school, an elementary technical school and a large hospital have also been provided by the Company, and a school for girls is now under consideration.

Engineering works.

30. In addition to the above, engineering works which cater for the public or for groups of mines are springing up, like those at Kumardhubi near Barakar, where also fire-bricks, silica and magnesite bricks are now being manufactured for the iron and steel furnaces. Another important industry in this district is the large pottery at Raniganj, where pipes, fire-bricks, etc., as well as certain kinds of pottery are produced.

The Deccan Cotton Tract.

31. The three most important crops requiring industrial treatment before transport, are cotton, jute and tea.

There are several parts of India where cotton is grown on a considerable scale, but the largest continuous area is that covering the northern Deccan, Berar, and the western districts of the Central Provinces and of Central India, where there are between six and seven million acres under cotton, nearly 700 gins and presses, and 35 spinning and weaving mills. The bulk of this cotton is exported to Bombay and Ahmedabad. When the railway began to serve these districts, at a time coinciding roughly with the cotton boom caused by the American War, most of the pioneer firms were European. Comparatively few, however, of the gins and presses are now in European hands, most of those so owned being the property of certain large export firms. The rest belong to Indian firms dealing in cotton, with their headquarters in Bombay or Ahmedabad, or to Marwari and other Indian traders carrying on business locally; only a small part of the capital has been found, and an even smaller share in the management has been taken by local capitalists or business men. The labour in these gins and presses is seasonal and unskilled; but the demand for it has appreciably raised the price of other local labour, and the need for field hands in the cotton-picking season tends to maintain it at a high level. Fitters and engineers are fairly numerous; the former have usually been trained in railway workshops or mills, and are, here as elsewhere, ready to seek their living in any part of India, wherever may be their original home; the latter are either passed pupils of technical institutions, such as the Victoria Jubilee Technical Institute, Bombay, or have learned their work in local concerns. Mills are not numerous; they are owned in some cases by local, in others by Bombay capitalists, and are operated by more or less permanently resident labour. The crop is financed partly by branches of banks with their headquarters in Bombay, especially the Presidency Bank, and partly by Indian financiers and dealers who belong mostly to Bombay or other parts of India. The inhabitants of these districts generally show a higher degree of enterprise than the people of the adjoining non-cotton areas to the east.

The above description will also apply fairly well to the cotton areas of the United Provinces, Gujerat, the Punjab and Madras; except that in Madras the gins and presses are to a somewhat larger extent in the hands of European firms, and in all these cases, except that of Gujerat, the arrangements for marketing and financing are less highly organised.

The Jute Districts.

32. The area under jute was 2,729,700* acres in 1917. The quantity produced was 8,839,900* bales of 400 lbs. each. The centres where the large buying agencies and the machinery for preparing the jute for export are situated are less numerous than in the case of the cotton tracts. Much jute is despatched to Calcutta unbaled, comparatively little diminution of weight being caused by the necessary cleaning and baling processes, while cotton is usually reduced about two-thirds in weight by the removal of the seed. The middleman is far more prominent here than in the cotton trade, owing to the smaller size of the individual holdings and to the necessity for sorting, bulking and grading the insignificant parcels of jute brought in piecemeal by the growers, before sufficient quantities can be collected to attract the larger buyers. The fact that much of the transport is by water also has some effect on the nature of the trade. The main buyers up country and in Calcutta are the employés of European dealers or manufacturers, or of rich Marwaris. The market in Calcutta, both for local consumption and for export, is nearly, if not quite, as active and speculative as the cotton market in Bombay. The cultivation of jute has brought a large amount of wealth into the eastern districts of Bengal; the local population is intelligent and unusually well educated for India. It is strongly averse, however, from undertaking manual labour for hire, and the crop is, as we have seen in the case of the Calcutta mills, handled by an increasingly large proportion of immigrant labourers from Bihar and the eastern districts of the United Provinces. These earn the highest wages paid for unskilled labour in any part of rural India except the Punjab, rates of Re. 1 and even more per diem being common in the busy season. The mechanical operations for the preparation of the crop are far less extensive and elaborate than in the case of cotton; artisans, engineers and labour of the factory type are, therefore, much less in evidence.

The Tea Districts of North-East India.

Growth of the tea industry.

33. The position in the tea districts of Assam and northern Bengal is very different. The area covered by the crop is comparatively small, and it is grown in otherwise undeveloped tracts; and though it is relatively valuable in proportion to its bulk and to the acreage on which it is grown, its economic and agricultural importance is less than is the case with jute or cotton. It is generally accepted that the tea plant is indigenous in Assam, where it is known to have existed in a wild state long before its cultivation and manufacture were seriously attempted. The first steps in this direction, indeed, were taken not for the exploitation of the Indian plant, but with a view to experiment with seed from China in different districts in India. And although at an early stage attention was prominently attracted to the existence of the plant in Upper Assam, for a number of years China seed was brought over regularly and its cultivation was—unfortunately as experience proved—encouraged in preference to that of the Assam plant. The first sample of Assam-made tea was sent to England in 1838, but it was some years before tea culture in India became a commercial success. At the outset the investigation had been undertaken by Government, who may in fact be said to have pioneered the industry, but once it was proved that Indian tea could be put on the market to compete with the China product, the real beginnings of the Indian tea industry were established. This may be dated from 1852, and by 1868 the total quantity exported amounted to eight million pounds; after that time progress was rapid. Within recent years more scientific methods of cultivation

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* Final forecast for Bengal (including Cooch-Bihar), Bihar and Orissa, and Assam.

have largely increased the average production per acre; for example, during the quinquennium 1885-1889, the average production per acre of the 310,595 acres under tea in all India was 291 lbs., while in 1916, the average production of the 650,823 acres under tea had increased to 566 lbs. Of the total production, north-east India, including parts of Assam and Bengal, is responsible for 90 per cent. and south India for 8 per cent. The total exports by sea in 1915-16 amounted to 338,470,262 lbs.; the corresponding figures for 1916-17 showed a decrease, but this was due to freight difficulties, a large quantity remaining for shipment at the close of the year; the value of exports in 1915-16 was £13,320,715. The industry gives permanent employment to more than 630,000 persons, while there are also in all the tea districts considerable numbers of people who do part-time work on the gardens.

Most of the more important gardens in north-east India are managed and financed by Calcutta agency firms, but recent years have seen an increase in the number of small Indian planters and companies. Every garden of any importance has its own factory where tea is prepared for the market, as it is essential that the various processes should be carried through immediately after the leaf has been plucked. The better organised factories are elaborately equipped with highly specialised plant and are under the supervision of expert tea makers.

Labour on the tea gardens.

34. The question of labour is one of much difficulty. Speaking generally, all the important districts have to obtain their labour from considerable distances, and this involves a heavy outlay and an elaborate machinery to control recruitment. Assam has always had to contend with special difficulties in view of its remoteness from the recruiting districts in the United Provinces, the Central Provinces, Bihar and Orissa and on the east coast; its importation of labour is regulated by the Assam Labour and Emigration Act, 1901 (VI of 1901), and, until recently, labourers were usually imported under a contract binding them for a period to their employers, to the breach of which penal conditions attached. Act XIII of 1859 is, however, in force in Assam; under this Act penalties can be inflicted for breach of contract on labourers who have received advances and wilfully refuse to carry out a contract to work.

Indigo in Bihar.

35. A word may perhaps be said in passing on the indigo industry of Bihar. Though the indigo area of Madras is far greater in extent, the production of its crop is but little organised. The Bihar crop, on the other hand, is mostly grown by or for European planters, who in some cases finance themselves, in others depend on the help of banks or agency firms. The labour employed is all local and of a rural type, and the manufacturing processes do not involve the use of much machinery. The educative and economic effect of the industry is therefore small. The interest of the subject, however, lies firstly in the planting system, and in the relations between the planter, as the owner or lessee of land and landed rights, and the ryots who hold under him; these have recently been the subject of special legislation, and it is therefore beyond our province to discuss them; secondly, in the struggle between the natural and synthetic products, in which the former had been, until the outbreak of the war, steadily losing ground. More systematic efforts, however, are now being made to enlist the resources of modern science on the planter's side.

Evidence put before us in Bihar left the impression that natural indigo, if cultivated and manufactured on scientific lines, offers prospects of great improvement, probably sufficient to enable it to hold its own in competition with synthetic indigo. In the following ways opportunities have been neglected in the past, and their recognition thus offers prospects of success, if followed up in the future :—(1) *The application of scientific agriculture,* (*a*) in the adoption of phosphatic fertilisers and other improved methods of soil treatment, (*b*) in the breeding of plant varieties able to withstand the wilt disease, (*c*) in the organisation of seed farms under suitable climatic conditions outside the indigo-growing district, and (*d*) in the rotation of indigo with other crops of marketable value ; (2) *The processes of manufacture,* (*a*) in the recent recognition of the fact that the precipitation of indigo is essentially due to a ferment, the cultivation of which under suitable conditions may permit of a great increase in the yield, and (*b*) in the preparation of a standardised product for the market ; (3) *The provision of improved financial facilities.*

By careful management under favourable financial conditions several planters have prospered, in spite of the absence hitherto of the advantages which the application of scientific agriculture might bring them, and, although it is impossible to estimate the prices at which synthetic indigo will be placed with profit in future markets, there is no doubt that the prospects before the natural product are sufficient to justify experimental work and enterprise in organisation along the lines indicated above.

The Railway and Government Workshops.

The railway workshops.

36. Mention has already been made of the private engineering workshops established to meet the rapid expansion of modern industrial needs, but by far the most important development of mechanical engineering in India is represented by the numerous locomotive and carriage-building shops which are an essential adjunct to the railway system. There are over 70 such shops and they are to be found in almost every part of India. The largest are the East Indian Railway locomotive shops at Jamalpur with 11,000 hands, the two Great Indian Peninsula shops in Bombay employing nearly 10,000 hands, and the North-Western shops at Lahore with almost a similar total, while the central workshops of the other more important railway systems also employ several thousand men each. It is the business of this army to keep in running order the rolling stock and equipment of the Indian railway lines.

Labour in the railway workshops.

37. These workshops date back to the time when the railways, to which they belong, were first started, and during recent years, in the case of many of the larger lines, they have been practically rebuilt, so that they now represent all but the very latest developments of modern mechanical engineering as applied to locomotive and carriage building. The labour employed is either Indian or Anglo-Indian, supervised and controlled by men brought out from England. Very few Indians have risen to the rank of foreman, and still fewer have been appointed to the superior establishment. With the dearth of Indian mechanical engineers we deal elsewhere ; but here it may be remarked that the failure of the railway workshops to turn out such men must be attributed to the lack of provision for training them, and we must add that this deficiency has hitherto been due to the lack of demand for such training owing to the absence of visible prospects for its recipients.

On the other hand, these railway workshops have been the main training ground for engineering artisans of every class, and, owing to the number of skilled foremen and chargemen, they have been most successful in this direction. In most of these workshops some form of apprenticeship exists, and the sons of workmen already employed are encouraged to follow in their fathers' footsteps. Very little has so far been done to provide any form of elementary technical training; but in recent years, the administrations of some of the railways have started classes, with a view of affording instruction to such of their younger workmen as were sufficiently well educated to avail themselves of it. From the railway shops, the artisans often drift into private employment. They also shift very freely from one railway to another, as the conditions of life round each workshop are very similar. The extent to which the country depends upon railway workshops for its supply of trained engineering artisans, however creditable to them, is an unsatisfactory feature of the situation; for, though the work is of a high type, it covers only a somewhat limited range of engineering practice.

Government workshops.

38. Although comparatively few in number, the Government ordnance factories, by reason of the high standard of work turned out in them, are also important centres for the training of certain classes of engineering artisans. These factories are situated at Cossipore, Ishapur, Dum-Dum, Kirkee and Jubbulpore, and each gives employment to several thousand men. Passing mention may also be made of the Marine Dockyards in Bombay and Calcutta and of the workshops maintained on a smaller scale by the Public Works Department to meet its own local needs.

Mofussil Distributing Centres.

Delhi.

39. The main distributing centres of India coincide as a rule with the more important railway junctions and are more typical of the comparatively land-locked tracts than of peninsular India. A description of Delhi will serve as a specimen, but it must be remembered that these centres differ only in size and in the extent of their trade and financial organisation from other distributing centres which are found on a greater or lesser scale all over the country, the smaller ones closely approximating to the market towns in rural areas which we have already described.

The population of Delhi consisted in 1911 of 232,837 persons who, apart from a few old families, relics of the Mahomedan imperial court, and the dealers in and makers of artistic wares, mostly earned their livelihood by the collection, preparation and distribution of manufactured articles and country produce. As in other places, facilities for finance and transport have led to the construction of a few spinning and weaving mills, and others for the manufacture of flour and biscuits and the extraction of oil. The trading community consists of a few Europeans, mostly representatives of large export and import firms with their headquarters at Bombay or Calcutta, managers and employés of local or branch banks and of one or two mills, and a number of Marwari dealers and financiers. There are also some representatives of Indian firms and of Bombay and Calcutta shops. Goods are received on indent or order from Europe or the Indian manufacturing centres of Bombay, Calcutta, Ahmedabad, and Nagpur. They consist mainly of piece-goods, yarn, kerosene oil, manufactured or partially manufactured articles of metal (among which sheet and bar iron, brass hollow-ware and sheets, and cutlery predominate), cheap ornaments and trinkets, umbrellas, and so forth. This trade is financed by the nine local branches of the large banks and by the Indian bankers of the city. The imports by rail into Delhi in the year 1916-17 amounted to about 431,000 tons, and the exports to about 168,000 tons; among the former, coal and coke, piece-goods, grain and pulse, metals and sugar were the most important, and of the latter, piece-goods, flour, hides and skins and sugar. Small traders in neighbouring towns purchase their supplies from the Delhi dealers, though this practice is being gradually supplanted by the opportunities of direct purchase from Bombay and Calcutta, which better trade information and closer financial relations between different parts of the country combine to offer.

Delhi takes a smaller relative share in handling country crops for export than in the distribution of imports. The buying agencies or sub-agencies of the larger firms, which rail produce direct to Karachi or Bombay are found in all the principal grain markets; and, in respect of the grain and seed crops raised in the vicinity, it is mainly as a market for local export or consumption that Delhi continues to hold its own.

Labour in the Delhi mills.

40. The mills employ the local labour, which is even less specialised and skilful than that of Bombay or Calcutta, and the cotton mills spin only the comparatively low counts for which the cotton of the district is suited. Engineers and fitters find their way here from larger manufacturing centres.

Mofussil Manufacturing Centres.

Cawnpore.

41. Cawnpore is a town on the Ganges with a population of nearly 200,000 persons. It is served by the main line of the East Indian Railway and branches of the Great Indian Peninsula and the Oudh and Rohilkhand Railways. It owes its origin entirely to European enterprise, having been selected as the site for a factory of the East India Company in the eighteenth century. The situation of the town on the Ganges, just beyond the limits of the kingdom of Oudh, in the centre of a fertile district and on the edge of the main cotton-growing tract of the United Provinces, soon made it an emporium of trade and necessitated military protection, while the subsequent advent of the East Indian Railway did much to develope its growing importance. A large arsenal was established here after the Mutiny, to supply the army with boots and leather goods which were manufactured by Indian contractors. In order to improve the quality of the locally made leather and to avoid the great expense of importation from England, the Government Harness and Saddlery Factory was started here in 1860 on an experimental scale; it proved a success and was put on a permanent basis in 1867. It was no doubt largely owing to the existence of these works that the Government Boot and Army Equipment Factory was started by private enterprise in 1880; it received a considerable measure of Government financial aid at the outset. But the first organised private industry started in Cawnpore was the Elgin Cotton Spinning and Weaving Company, which was founded in 1862. The large quantity of cotton passing through Cawnpore, the financial facilities afforded by an important trading centre, and the cheap labour of the thickly populated areas round, were the chief inducements to its promoters. One factory has followed another, and in 1915 the city contained five large leather factories and a number of small works and tanneries, employing over 6,000 hands in all, six cotton mills with 4,647 looms and 340,000 spindles, employing over 11,000 hands, four tent factories, a very large woollen mill, three sugar factories, an engineering works, a chemical works, two large flour mills, a brush factory, three oil mills, and a number of cotton gins and presses. There is also a central electric generating station supplying both light and power, including that required for working the tramway system.

Cawnpore is also an important collecting and distributing centre. Imports amounted in 1916-17 to 599,000 tons, consisting chiefly of coal and coke, cotton, piece-goods, hides and tanning materials, raw and refined sugar, salt, food-grains, oil seeds and metals; exports were 319,000 tons, mostly of raw cotton, piece-goods and yarn, hides, leather, refined sugar, salt, and oil seeds. Its trade, both export and import, is in the hands of several large European branch firms and of a number of Indian merchants and bankers, but the most important industrial undertakings are still controlled by the local European firms, who founded them in the first instance, or took them over at a comparatively early date in their history. One well-known local industrial firm with previously existing large interests in Calcutta subsequently started a branch in Cawnpore to handle the trade in indigo seed, which was and still is largely grown in the tract between the Ganges and the Jumna.

Labour in Cawnpore.

42. The operatives in the factories, especially in the tanneries and leather works, are mainly *chamars*, who were originally village labourers and tanners. Labour is comparatively plentiful and moves into Cawnpore freely from the densely populated rural districts which surround it. Sample wages in 1918 were as under (in rupees and annas per mensem).

	Rs.	As.
Cotton—		
Grinders and strippers	9	8
Sizers	15	0
Warpers	20	0
Drawers	20	0
Weavers	15 to 30	0
Wool—		
Unskilled labour	8	10
Mule minder	17	5
Piecer	8	1
Leather (Army Boot Factory)—		
Un-hairers and fleshers	12	0
Scourers and setters	12	0
Slicker whiteners	16	0
Machine operators	21	8

More has been done in Cawnpore for the housing of labour by the large industrial concerns in proportion to the numbers employed, than in almost any other city in India. Settlements have been established by two companies, providing accommodation of a superior kind for about 4,000 people in each case, at a convenient distance from their factories.

Other Industrial Centres.

43. This account may, we trust, be thought sufficient for our purposes as a sketch of the general industrial position in India. But we are deeply conscious of its incompleteness and, had space permitted, should have preferred to present it in much greater detail. Assam possesses extensive forests and large areas of culturable waste land, and presents important future industrial possibilities to which we have not been able to do sufficient justice. The Madras Presidency, with its varied physical features and wider range of climates than any other province of India, grows a large variety of crops of high economic importance. Although its coast line is of great length with numerous little ports, these are mere open roadsteads, but at the Presidency town the difficulties and dangers of a surf-bound coast have been successfully surmounted. Certain deficiencies in its natural resources have hitherto

hindered industrial development, and modern manufactures have grown only to a limited extent. On the other hand, there are numerous towns in which indigenous industries still flourish, and the craftsmen exhibit a high degree of skill and have accepted modern methods in many cases. Madura is a centre of extensive weaving and dyeing industries, and Kumbakonam of weaving and of metal work in copper, tin and brass. The tanning industry flourishes in many towns and has given rise to a large export trade. The possibilities of the Punjab are, it is true, mainly agricultural, but its industries are growing and are spread over many districts. This province possesses special advantages in respect of water power, which are bound to tell in the future, and its people exhibit a natural aptitude for engineering. Turning to the Central Provinces, the city of Nagpur contains a thoroughly up-to-date cotton mill and a large colony of hand-loom weavers, and the manganese field in its neighbourhood has been the principal Indian source of this mineral. In Sind there is the prosperous and growing port of Karachi, which is the chief outlet for the grain exports of northern India. Ahmedabad is an important up-country city which ranks second only to Bombay as a cotton-manufacturing centre. It contains a population of well over 200,000 and no less than 60 cotton mills, which produce nearly one-fourth of the cotton goods made in India; and its oil-pressing industry has made very marked progress in recent years. The mere mention of such important areas and towns is all that we can attempt; but as the main questions dealt with in our report, such as the finance of urban and rural industries, the interdependence of agriculture and industries, the relative efficiency of labour and the conditions under which it works, are perhaps not very dissimilar throughout India, we trust that the specimen descriptions which we have given in this chapter may be accepted as a sufficient introduction to the subject matter of our enquiry. We must, however, admit an exception in the case of the province of Burma.

Burma.

44. Conditions in Burma are in many respects different from those prevailing in India, and many of our general remarks are not appropriate to that province, whilst our recommendations have been framed to meet the situation in India as a whole, and must be modified in some measure before they can be applied to Burma.

Agricultural description.

The delta and the lower valley of the Irrawaddy, with their heavy rainfall, produce little but paddy. The villages are far apart and appear even smaller than they are in comparison with the wide stretches of rice fields which, in the fully cultivated districts, lie between them. Gangs of agricultural labourers come over from India for the cultivating season, and thereafter work in the rice mills; but this state of affairs is found only near Rangoon. Throughout the rest of Burma the people of the country carry out the operations of agriculture, and have extended the cultivated area with striking rapidity. The result is that the country can at present export annually some 2½ million tons of rice from an area of little over 10 million acres under paddy, a position which the natural increase of the population, especially if accompanied by a diversification of cropping, may in course of time materially modify.

The middle section of the Irrawaddy valley comprises what is known as the dry zone, with a rainfall not exceeding 40 inches and often less. Here paddy is confined to low-lying or artificially irrigated fields, and is a more precarious crop than in the regions of heavier rainfall. Cropping is more diversified, and includes cotton in places, sesamum, and various beans and pulses, usually grown as sole crops. Except in the neighbourhood of the larger towns there are no roads, and the chief means of communication are the river and its creeks and, to a less extent, the railways. We did not visit the portion of Burma lying above Mandalay, where the rainfall is again higher and paddy once more predominates. The excessive dependence of Burma on the paddy crop is a very marked feature of its agriculture. Even from this point of view, such dependence is undesirable, and a greater diversity of cropping would place agriculture on a wider and, therefore, a safer basis, and almost certainly provide raw materials such as cotton, jute, sugarcane and oil seeds for local industries. Considering the great task of agricultural education and development that awaits it, the local Department of Agriculture is conspicuously lacking in equipment, and possesses practically no organisation for the training subordinate staff.

Forests. 45. Even in the plains and valleys there are wide areas of forest, consisting of teak and other species, usually far from homogeneous; in the hills, the unending jungle is only occasionally broken by clearings and villages. The reserved forests cover nearly 29,000 square miles, which yielded in 1915-16 only one cubic foot of timber per acre. The unclassed forest areas, of about 114,000 square miles, are awaiting further development, either by their systematic exploitation as forests, or by being opened up for agricultural colonisation. The gross revenue from this vast property is at the rate of about eight annas per acre of the reserved forest, and the expenditure amounts to about four annas. Obviously, there is room for enormous development. Alongside of the numerous tributaries and creeks a fair amount of timber has been extracted, mostly teak, which, being lighter than water, is easily floated out in rafts. The very valuable hardwood timbers have scarcely been touched, except in the case of a few species, and these only to a limited extent and mostly for local consumption. The timber for export is mainly teak and is almost entirely removed by private firms who hold 15-year renewable forest leases. Such temporary roads and railways as are required are put down by these firms. The possibilities of the forests are thus not only inadequately exploited, but are imperfectly known, and the evidence tendered to us goes to prove that the expert forest staff requires reinforcement even more urgently than in India.

Organised industries. 46. Among the organised industries of Burma are paddy milling, the timber trade, the extraction and refining of mineral oil, and various other mineral ventures, the most important of which in their ultimate bearing on the industrial development of India generally, are the winning and treatment of the lead, silver and zinc ores of the Bawdwin mine in the Northern Shan States, and the wolfram and tin mining of southern Burma. The preparation of rice, timber and oil for export and consumption mainly centres in Rangoon, which is the capital and the main port of Burma, and is conveniently situated for the receipt of produce from the railway and the Irrawaddy river alike. The trading and industrial population of Rangoon is, to a striking extent, non-Burman. The export and import trade is in the hands of European, Chinese and Indian firms, and the industrial processes are mostly carried on under European supervision and with European capital. The latter remark applies also to the extraction of timber and oil and to the mining industry generally. The fact that most of the industrial and trading operations of Rangoon are on a large scale has prevented the Burman hitherto from taking any prominent share in them, and the great increase in agriculture has hitherto absorbed most of his energies. Except in those towns which are based on trades or industries of modern growth, the urban population is, speaking generally, not gaining ground, a fact which is in its turn due to the large areas of fertile waste land hitherto available to the settler. The absence of congestion in the quarters occupied by the operative classes in Rangoon is a welcome feature which deserves note in passing.

Small and cottage industries.

47. The small indigenous industries consist of weaving (mainly silk), wood carving and carpentry, lacquer working, metal working and pottery. They present several features widely differentiating them in character and organisation from the corresponding industries in India. Considering the size of the industries themselves and the number of persons engaged in them, a relatively large proportion of the articles produced appear likely to command a sale in other parts of the world. Whether this is due to the greater skill of the Burman artisan, to his distinctly higher standard of comfort, or to the fact that his indigenous arts have so far been less affected by the penetration of western manufactures, it is difficult to say.

Women in Burma take a large share in domestic industries; they weave ornate fabrics, and carry out with their own hands many of the most difficult and skilled processes in other industries. Incidentally, they perform for their own households the work done in India by barbers, washermen, water carriers and the like. Another very noteworthy feature and one which should facilitate measures for the improvement of many minor industries, is the fact that the village artisan is not, as in India, part of the village system. Weavers, it is true, tend to form separate colonies in most parts of the world, but in Burma potters, blacksmiths, carpenters and cobblers are found in groups, which supply areas limited only by the portability of the article made in relation to its value.

Although the Burman does not compete with, or to any large extent invest in, the considerable organised industries of Rangoon, he is far from backward in establishing small rice, timber and oil mills further up country, a branch of development which may be expected to expand as the more fertile waste areas come gradually under occupation. The Burman has no prejudices or traditions to deter him from industrial work, and there was evidence forthcoming to show that, although inexperienced in business and account keeping, he has distinct possibilities as an industrialist.

A serious handicap to local trade and industries up country is the absence of banks; for instance, the only branch bank in the Irrawaddy valley is one at Mandalay. The financing of trade and of such industries as exist is in the hands of Madras Nattukottai Chetties, who charge very high rates of interest, and replace their agents as a regular practice every three years, which is apt to tell hardly on their clients. Co-operative banking has been pushed relatively further in Burma than in any other Indian province, and extends not only to credit, purchase and distribution, but even to production, *e.g.*, of sleepers and road metal by Burman petty contractors, who were previously in the hands of Chetties; whilst evidence placed before us showed that in one district a small agricultural bank had achieved considerable success.

Lack of coal.

48. There is, however, one striking natural deficiency in Burma to which we must refer. Although the country has not been fully explored by geologists, it seems probable that it contains but little coal, and that mostly of poor quality. For fuel, the local industries must either pay the high price of imported coal, burn wood, or use oil. Wood will probably come into more extended use in future through more economic processes, but timber has a competing value in other ways. The existing oil fields are also being rapidly drained, and the new ones that have been tested, show no signs of replacing the three main fields of Yenangyaung, Yenangyat and Singu. Thus, for the future, Burma must look to the greater utilisation of water power, and here, as in India proper, it is desirable to organise a hydrographic survey, so as to be ready to meet industrial demands of the future.

CHAPTER III.

RAW MATERIALS FOR INDUSTRIES.

Agricultural Products.

Agricultural products as a basis for industries.

49. In order to complete this general picture of the industrial position in India, it is necessary to give a brief account of the raw materials and natural facilities available.

Although it must be clearly recognised that Indian industries are now, and will be in future, chiefly based on the agricultural products of the country, we find that, important and valuable as these are, much still requires to be done for their development. The extent to which they are manufactured whether for export or internal consumption, instead of being sent out of the country as raw materials, can, in some cases, be largely increased; and the Agricultural Department will find great opportunities and sometimes an urgent necessity of improving the output and quality of many Indian crops. In the case of cotton, a note appended to this report (Appendix B) will show the Indian and world position of this crop. The quantity of short-staple cotton raised is much larger than is necessary to supply the demand of the Indian mills, and a surplus is available for export, which foreign countries readily take. At the same time the Indian mill-owners are beginning to feel that, if they are to enjoy an appreciable share of the more profitable trade in finer goods, more long-staple cotton must be grown in this country. The external demand is mainly for raw cotton and is rendered effective by the imposition of tariffs in the importing countries, which has severely restricted the development of the Indian export trade in cotton goods. The note also illustrates strikingly the necessity for further botanical research. It has been left in its draft form, as it has already been seen unofficially by the Government of India, by whom it was used to support their proposals for the appoinment of the Indian Cotton Committe of 1917-18.

Cotton.

Sugarcane.

50. Turning to sugarcane, although India possesses a larger acreage under this crop than any other country in the world, her imports of sugar have grown in recent years with very great rapidity, and, before the war, were exceeded only by those of cotton manufactures. The obstacles in the way of increasing local production lie mainly in the poor type of cane and the inferior cultural methods in the principal cane areas, the United Provinces, Bihar, Bengal and the Punjab; and in the very small holdings on which cane is grown, with the consequent impossibility of securing the regular supply requisite for a modern central factory. The position has been examined in a separate note (Appendix C).

Cotton has recently been the subject of attention by the Government of India, owing doubtless to its importance from the point of view of the world supply. But sugar is of almost equal interest to Indian consumers, and may, we have shown, prove the foundation of a great Indian industry. We think that the facts which we have collected regarding these two crops, though they include nothing that is not already well known to students of the subject, are sufficient to prove the necessity for a close investigation of Indian industrial crops, and for the creation of scientific and industrial departments of Government fully equipped to carry on such work. Rich results are already being obtained from the work of the Agricultural Department; but hitherto, owing to the lack of staff, there has been no concentration of effort on the crops which afford products suitable for local manufacture and are, therefore, potential creators of wealth for other classes than the agriculturist.

Fibre crops other than cotton.

51. Among fibre crops, in addition to cotton, there are jute, *sann* hemp (Crotalaria juncea), Bimlipatam jute (Hibiscus cannabinus) and various others of less importance. Jute is already very fully exploited from an industrial point of view, though many possibilities exist of the improvement of the crop itself. About half the crop is manufactured in the country, enough to cover its internal needs many times over. Of the other fibre crops, there is little or no organised manufacture in India at all. Although these are far less important than jute or cotton, they have in some cases valuable qualities, and can be made into articles for which there is a ready demand. There are also fibre crops such as sisal hemp, flax and rhea, which, though suitable for India, are either not grown in the country at all, or only to a very limited extent, and some of these, such as flax, are required for manufactures of national necessity.

Oil seeds.

52. Oil seeds are extremely important, both from the agricultural and from the export point of view. The areas covered by the principal oil seeds and the pre-war value of exports are shown below.

Crops.	Area in 000 acres. 1913-14.	Value of exports Rs. 000. 1913-14.
Castor	Not shown separately.	2,05,00
Copra	Ditto	1,55,06
Cotton	15,844	2,12,51
Groundnut	463	4,88,14
Linseed	2,268	6,68,71
Rape and mustard	4,083	4,47,37
Sesamum	4,278	2,70,43
Total non-essential oil seeds	14,658*	27,50,06

* Excluding copra and cotton.

A very large proportion of the produce is exported; much of the balance is crushed either by small power plants or in country bullock mills, the latter of which are very inefficient in oil extraction. The few mills of more modern type have found great difficulty in marketing their cake locally, and have also, in some cases, made serious mistakes in their technical management or business arrangements, in the absence of proper advice. Little has been done hitherto by the over-burdened Agricultural Department to improve the local types of oil-producing plants or to investigate the conditions under which the oil is formed in the seeds. The methods of oil extraction have been equally neglected, and we recommend that this important matter should be examined by the experts who, we hope, will be available in the future. We recognise that the success of large-scale mills producing oil for export depends not only on the skill with which they are worked and on improvements yet to be effected in the means of transport (such as possibly the adoption of carriage in bulk), but on an even more important factor—the tariff policy which may be pursued in India and elsewhere. The proposals that we are making to provide scientific and economic assistance should enable increased attention to be paid to the improvement of

Indian crops, and our recommendations regarding the provision of facilities for the purchase of machinery and plant should lead to a great development in the methods of preparing them for the market.

Hides and leather.

53. In the case of hides, it is a well-known fact that the majority of these were before the war exported to Germany, and that the export hide market of Calcutta was entirely in the hands of German firms or firms with German affinities, who were bound by trade arrangements to sell to the continent through a ring of German dealers at Hamburg and Bremen.

In Madras, the export of raw hides is negligible, but large quantities of both hides and skins are shipped in a lightly-tanned condition. As a result of the measures introduced since the outbreak of war to stimulate the export of 'East India kips,' as these hides are called, this industry has made a considerable advance. In Bombay, there are a few tanneries which prepare hides for shipment in a similar fashion. In addition to the valuable trade in raw hides from Calcutta, large quantities were also exported in a raw state through Karachi and Rangoon. The export of raw skins is considerable from all ports, especially from Bombay, Karachi and Calcutta.

The village tanner finds that the continued rise in prices is placing local hides to an increasing extent beyond his reach. His methods are in any case extremely inefficient; he has been justly described as 'making a good hide into bad leather'; and there seems little hope that his industry can or will ever deserve to be saved. The organised tanneries vary in size and efficiency from large concerns employing upwards of 2,000 hands even before the war, to the numerous Indian-managed tanneries, the smaller of which employ only a few dozen men. The principal difficulty at present is the lack of organisation and expert skill.

Chrome tanning so far has made comparatively little headway in India, chiefly owing to the fact that its processes are highly technical, requiring chemical knowledge and an elaborate equipment of machinery. Progress in recent years, however, especially since the outbreak of war, has been more rapid, and considerable quantities of special forms of chrome leather, for which the Indian hides are particularly suitable, have found a ready market in London.

Vegetable tanning materials of good, though unequal, quality are found in most parts of India. The two chief agents used hitherto have been *babul* (Acacia arabica) and *avaram* (Cassia auriculata) bark. *Dividivi* (Cæsalpinia coriaria) and myrabolams (Terminalia chebula) are in local demand and are also very largely exported. Mangrove bark is available in Bengal and other places along the sea-coast. Numerous other trees and shrubs are also used in different parts of the country by village tanners, and their properties are now (1918) being systematically investigated under the orders of the Indian Munitions Board. But the machinery for the collection of vegetable tanning agents is not at present sufficient to produce a supply adequate to the largely increased demands which arose, owing to war conditions, in the year 1916 and onwards. The preparation of tannin extracts has been tried from time to time, and generally without much success, but the conditions under which such attempts have been made were not satisfactory, and should not preclude further work in this direction.

54. Here, again, the exclusion of the question of tariffs from our terms of reference renders us unable to recommend any complete scheme for dealing with the situation; but we are decidedly of opinion that an important feature of any such scheme must be the extension and improvement of

the tanning industry, both in respect of the lightly-tanned hides of Madras and the completely tanned and curried leathers of the large Indian tanneries in Cawnpore, Bombay and elsewhere. We recognise that, among other initial difficulties, this industry will be exposed to the risk of organised competition from hide exporters. It must, therefore, in any case be established on a considerable scale, though it will be impossible for India to tan all her own hides for some time to come. We also recognise that India will, for an even longer time, be unable to consume all the leather that will be produced by an extension of the industry on a scale sufficiently large to withstand the competition of exporters of hides, while tariff bars against the importation of leather exist in many foreign countries which admit hides freely.

In view of the importance of the question, we have prepared a separate note (Appendix D), discussing the position in detail and embodying certain definite proposals.

Minerals.

India's mineral resources.

55. The nature and extent of the mineral deposits of India have been systematically examined by the Geological Survey Department, although it has been impossible for it, with limited funds for establishment and prospecting equipment, to carry its investigations, except in very special cases, to a point which would warrant commercial exploitation without further detailed enquiry. The mineral deposits of the country are sufficient to maintain most of the so-called "key" industries, except those that require vanadium, nickel and possibly molybdenum.

It is unnecessary here to repeat in any detail information which is already available to the public in the records of the above department. As has already been shown, Indian coal is very unevenly distributed and generally poor in quality. The deficiency is especially noteworthy in the case of Madras and Bombay. Iron ore is found in many parts of the Indian continent, but the instances in which ore of good quality exists in suitable proximity to satisfactory coal supplies are not very numerous, though sufficient in all probability to warrant large extensions of the existing iron and steel works. A rich deposit of lead and zinc ore exists in the Shan States of Burma, but, although the mine is in active operation, no attempt has hitherto been made to smelt the latter metal in India. The copper ores of Singhbhum, a district of Chota Nagpur, have as yet scarcely been exploited, although a mine has been developed and smelting works have been erected and have already started operations. High-grade chromite is produced in large quantities in Bâluchistan. The bauxite deposits of India, the best and largest of which are found in the Central Provinces, were made known to the public by the Geological Survey some years ago, but have not yet been used as a source of aluminium. Manganese ore is extracted in very large quantities in the Central Provinces, and to a less extent in Chota Nagpur, Bombay, Mysore and Madras. At present it is mainly exported in a raw state to other countries, although the two existing iron and steel companies have, since the war, manufactured considerable quantities of ferro-manganese.

South Burma is one of the richest sources in the world of tungsten ores, occurring in the form of wolframite, the best known ore of this metal, which has now become almost indispensable to mechanical engineering as an ingredient in "high-speed" steel. Tin is also found there and in other parts of Lower Burma, and successful dredging opeartions are carried on in Tavoy. Ores of antimony are found in the Shan States, in Tenasserim and in Mysore, but none of these has yet been successfully exploited.

Mica.

56. India also takes the first place among the mica-producing countries of the world. The Bihar mica is of the highest grade so far raised in large quantities. The mineral was, until recently, won almost entirely by small workings, but some of the larger firms interested are now beginning to apply more scientific methods. Micanite has already been made experimentally at Kodarma, and works will probably be established on a permanent basis before long; it is also manufactured in the East Indian Railway workshops at Jamalpur.

Cement and pottery.

57. Cement works have been started at Madras, Bundi, Porbandar and Katni. The factories are equipped with plant of modern design, and the quality of the cement produced is officially reported to be satisfactory. They are, however, only able to meet part of the Indian demand, and though the cost of manufacture is believed to be low, the price of this commodity to the public is still controlled by the rates at which it can be imported. A sufficient reduction in the price of cement would lead to a great extension of its use, especially for lining irrigation canals and channels with the object of preventing waste of water.

Experiments in the suitability of various clays for pottery purposes have recently been conducted in the Bombay School of Art and elsewhere, with results that should be made more widely known.

Glass.

58. Sand and lime suitable for the manufacture of glass occur in many parts of India, but hitherto only partial success has attended the working of the few glass factories that have been established, while failures have been frequent. But it by no means follows that glass cannot be successfully made in India. What has been most conspicuously lacking hitherto has been a complete and systematic investigation into the economic possibilities of glass-making in the different parts of India, including the price of fuel and raw material, and the distance and extent of markets. The prospects and position of the glass industry in India generally form the subject of a separate note (Appendix E), which clearly demonstrates the necessity of considering not only the economic but also the technical side of a new venture, and of employing a number of specialised experts before taking up a complex industry.

Saltpetre.

59. India possessed at one time a practical monopoly of saltpetre, which is found in the plains of Bihar, the United Provinces and the Punjab, and extracted and refined by indigenous methods. Owing to its occurrence in admixture with salt, its preparation has hitherto been safeguarded by various excise precautions, which are alleged to have weighed heavily on the industry, though it has expanded greatly under the stimulus of increased prices during the war. Indian saltpetre had previously been supplanted to a large extent by the potash mines of Germany and the nitrate deposits of Chili. A separate note on this industry also (Appendix F) is attached to this report.

Forests.

The extent and value of the Government forests.

60. The area of forests under the control of the Forest Department in 1915-16 was 249,000 square miles, of which 99,205 square miles were reserved. The total outturn was 286 million cubic feet of timber and fuel, and minor produce valued at Rs. 116 lakhs; of these 179 million cubic

feet and Rs. 88 lakhs worth of minor produce came from the reserved forests. This gives a yield per square mile of 1,149 cubic feet of timber and fuel, and minor produce valued at Rs. 47 from all classes of forest; and a corresponding yield of 1,809 cubic feet and Rs. 90 worth respectively from reserved forests only. For the forest produce of Native States, no complete figures exist. India imported 96,000 tons of timber valued at Rs. 74 lakhs in 1913-14, the last year before the war. In spite of freight difficulties, there has not been much relative decline under this head during the war years, a fact which shows the necessity to India, under present conditions, of these imports. Against this (according to Statement No. XV of the Statistics relating to Forest Administration) the exports of forest produce in the same year were valued at Rs. 454 lakhs. The largest items of this total, *viz.*, caoutchouc (Rs. 79 lakhs) and lac (Rs. 196 lakhs) are by no means exclusively, or in the former case even chiefly, derived from Government forests; the principal export which can be assigned wholly or mainly to this source was teak, valued at Rs. 78 lakhs. The value of other timbers (excluding sandalwood) was only Rs. 7 lakhs.

The following figures illustrate the financial aspect of forest management. In addition to forest produce removed free or at reduced rates, valued at Rs. 85 lakhs, the total receipts of the Forest Department for the year 1915-16 amounted to Rs. 310 lakhs, and the expenditure to Rs. 178 lakhs, yielding a surplus income of Rs. 132 lakhs. The expenditure on roads and buildings was just under Rs. 12 lakhs, though in the last year of peace it amounted to Rs. 18 lakhs. To these figures should, presumably, be added a share of the cost of the supervising staff shown under the head of administration; but, on the other hand, a large amount of the expenditure must presumably have been on account of maintenance of existing works. The importance of these figures arises from the strong evidence received by us in many provinces of the inadequacy of the forest staff for the work of exploitation and commercial development, especially in the higher grades, and of the urgent need for improved forest communications. The expenditure on the Imperial Forest College and Central Research Institute was only Rs. 2·87 lakhs, much of which was, moreover, incurred in the training of recruits for the department.

Incomplete use made of forest resources.

61. As the above figures will have shown, the national forest estate is of vast extent and value; but a scrutiny of the output per square mile proves that its actual yield has hitherto lagged far behind its possibilities, and is, in most areas, greatly in defect of what the natural increment must be. The chief needs of the Forest Department are undoubtedly the development of transport facilities; the exploitation of the forests on more commercial lines; and the extension of research and experimental work, which should, when necessary, be carried out on a larger scale and under commercial conditions. All these deficiencies point to the necessity for more staff.

Turning first to the question of communications, we find that those portions of the forest estate which are favourably situated for export, for industrial exploitation or for the very important agricultural demand, have been utilised fully, sometimes too fully, but generally, in the absence of a proper system of transport, not on the most economical lines. The same lack of transport facilities leaves valuable and extensive areas of forest, especially in Burma, in Assam, in the Himalayas and in the hilly tracts of the west coast, very largely unexploited, while quantities of timber are imported by sea from distant countries. The difficulties of transport in these forests, remote from commercial centres, are great. Many valuable timbers do not float, while water carriage of those that do is rendered difficult by the intermittent nature of the streams in many parts; or by obstructions in the hill sections of rivers with a perennial water supply. In most forest areas, railways, ropeways and tramways are non-existent, whilst even passable cart roads are often wanting. Difficulties of these kinds have, however, been successfully overcome in other countries, and we see no reason why they should not be conquered in India also. We understand that, to deal with special problems of this nature, the Government of India are contemplating the recruitment of a number of forest engineers from countries where forest engineering is practised on a large scale, and have held that ordinary work such as the construction of roads, buildings and simple tramways can be carried out by the forest staff, with such assistance as may be necessary from the local Public Works officers. To the first of these propositions, as a temporary measure, we desire to lend our hearty support; but as regards the second, we consider that the heavy routine duties of the existing superior forest staff, in connection with the conservancy and improvement of the forests and the exploitation of their produce, render it impossible as a rule for such officers to devote time to the question of transport facilities. It would be more economical to employ a full staff of forest engineers, in which experts in special forms of forest engineering would eventually be included, graded in such a way as to make the prospects of such a separate branch of the Forest Service in itself sufficiently attractive. We propose below that the extraction of some classes of forest produce should be undertaken through the agency of this staff.

62. Another important deficiency to which we desire to draw attention is the absence of information of commercial value regarding the products of the forests and of commercial methods in rendering them available for industrialists. We would refer specially to the advantages which would arise from putting the timber on the market as far as possible in the form of standard scantlings. In certain cases, especially in Burma, the exploitation of timbers has been handed over to private agency on long leases: the Forest Department claims that such an arrangement is pecuniarily disadvantageous to Government, and there is evidence to show that private firms are unwilling to remove or unable to find a market for the less known timbers which are usually too heavy to float. We consider that Government should have at its disposal a staff which will enable it to play a more direct part than hitherto in the exploitation of its own forest estate, in order to obtain a larger share in the yield thereof and to ensure a fuller use of the many valuable species hitherto untouched. The members of this staff need not be trained silviculturists; they would be generally guided in their selection of timber for removal by the direction of highly qualified officers of the regular forest staff, under whose orders they would work. They should be capable of judging whether a particular tree is in a condition that will repay exploitation; but for the rest, their work in organising the removal of timber would be a form of engineering, and would bring them into intimate touch with transport questions. They might thus suitably form part of the service of forest engineers which we have just proposed. They would not be directly concerned with the selling price or the marketing of timber, matters which would be dealt with by selected forest officers on lines suggested by us below. It will, of course, be understood that the employment of special men for the collection and removal of forest produce will only be necessary in certain special cases, where the value of the timber and the difficulties in the way of its extraction warrant such a course. Due provision should be made for the future training of Indians in this country as forest engineers for ordinary and for special classes of work.

Timber removed under Government agency, otherwise than to fill definite orders or for local consumption, will require, especially in the case of the less known species, special arrangements to bring it to the notice of consumers and render it available for them. The officers controlling depôts established for this purpose should be selected for their commercial aptitude, and should keep in close touch with the various Departments of Industries and through them with consumers.

Necessity of a link between research and commercial exploitation.

63. In respect of the third requirement of the department, research and experimental work, we consider that the equipment of the Forest Research Institute at Dehra Dun is wholly insufficient. We observe that the Inspector-General of Forests is of opinion that the staff should include (1) a wood technologist, (2) a pulp expert, (3) a tan and dye expert, (4) a minor produce expert, to be employed on research work only. We agree generally with these suggestions, so far as they go, and we propose in Chapter IX a scheme in accordance with which suitable specialists will be available for research in these subjects. Something more is, however, needed; there is a very marked absence of a practical link between the work of the laboratory experts at the Forest Research Institute and the development of successful commercial undertakings. A forest economist was appointed to supply this link, but the difficulties of the position and the variety and extent of the duties which have fallen to the lot of this officer were at the outset inadequately estimated. At present he has only one assistant and has to share with the other research officers the services of a single chemist. The Forest Economist is expected not only to have a basic knowledge of forestry, but to know enough of the chemical, drug, oil and other trades to give adequate answers to all sorts of miscellaneous enquiries, as well as to detect and follow up promising raw materials. The present arrangement by which a single officer is detached for a task that requires the knowledge of a dozen specialists, is not only unfair to the individual but eminently unsatisfactory to the department.

Failures to develope industries dependent on forest products.

64. Several instances have been brought to our notice illustrating the possibilities of the commercial development of various descriptions of forest produce on new lines; and the failures and successes recorded seem, in our opinion, to point clearly to the correct solution. We will first therefore briefly describe them and then formulate our proposals.

The Bulletins of the Forest Department are often of great value, but one issued some years ago regarding the suitability of Indian timbers for match making has been cited feelingly by several witnesses, as an example of the danger of recommendations based upon incomplete enquiries, especially in the absence of data obtained from actual practical experience.

Some preliminary work has apparently been done in connection with the antiseptic treatment of timber. But we believe that this has not been carried out on a scale and under conditions that will give results on which action can be taken commercially.

Very definite recommendations have been made as to the suitability of bamboos for the manufacture of paper pulp, and excellent paper has been made from such pulp; but even before the war, business men were obviously reluctant to develope the concessions that they had obtained. So far as can be ascertained, the reasons for this hesitation were the lack of adequate information regarding the cost of transport of the raw material and doubt as to the capital outlay necessary on plant and machinery, coupled with uncertainty as to the cost and quantity of the chemicals required in the manufacturing processes. Finally, there was a fear lest the infant undertaking might be crushed by the dumping of wood pulp from Scandinavia or North America, and there was the knowledge that Japanese experiments in this direction had not proved successful. The position of paper pulp in India after the war will undoubtedly depend very largely upon the manufacturing conditions in other countries, upon fiscal regulations and upon the cost of transport overseas. It would appear, therefore, if the above line of argument is correct, that we have here a good case for a Government pioneer factory. It might or might not prove commercially successful; but it would certainly, if properly managed, provide adequate data to determine the commercial possibilities of the bamboo as a source of paper pulp, when normal conditions are re-established.

The history of the attempts to establish wood distillation in India also indicates the desirability of an organisation for commercial experiment, such as is now under discussion. The subject was independently taken up by the Director of Industries in Madras and by the Superintendent of the Government Cordite Factory at Aruvankadu. Later on, these two officers co-operated; but their proposals were generally viewed by the Forest Department with misgiving, and no useful assistance was rendered. The subject of wood distillation has been treated throughout as a matter of academic interest rather than as one of vital importance. The result has been that India has failed to establish an industry which, at the present time, would have been of the greatest national value.

We see, therefore, that some link is needed between the research officers and the commercial public, to create confidence among the latter in the results obtained by the work of the former. The type of mind best qualified to undertake scientific research is probably the least adapted to deal with commercial matters.

Success of correct methods of pioneering.

65. Instances of the correct method of dealing with problems of this sort, however, are not wanting, and in two cases at any rate success has been achieved, though here too their history confirms us in our views as to the necessity for close co-operation between the preliminary scientific research and the subsequent commercial development.

The beginnings of the present resin factory at Bhowali in the United Provinces, date back some 27 years. We understand that it received assistance in its later stages from the Research Institute; but originally in the absence of any officer with an expert knowledge of turpentine distillation, it was developed on a system of trial and error, with consequent waste of money, and is even now far from satisfactory. On the other hand, the factory at Jallo, near Lahore, has attained a much greater degree of success in a far shorter time, not so much from any help it derived from the experience of the Bhowali factory, as because the officer who was to design and work it was given the opportunity of acquiring expert knowledge of turpentine distillation under commercial conditions in other countries.

Before leaving this subject, we desire incidentally to draw attention to the fact that both the turpentine and the rosin produced at these factories differ in chemical constitution from the corresponding substances produced elsewhere, and to the opportunities presented by this fact for a fresh series of researches to discover the precise nature of these differences, and whether these may not perhaps indicate the existence in the Indian products of substances of special commercial value. The continuance of research in such cases is most desirable, not only in the hope of fresh discoveries, but in order to forestall possible competition.

66. Reference may also be made appropriately to the success achieved in the distillation of sandalwood oil by the Mysore Government. In this case, the

work was initiated by the State Department of Industries consequent upon the dislocation of the trade in sandalwood, which ensued soon after the outbreak of war. The preliminary investigations were made by the Director of Industries with the assistance of the staff of the Applied Chemistry Department of the Indian Institute of Science. It was necessary to get results quickly, and the resources of both the State Department and the Institute of Science were concentrated on the problems which arose. Subsequent developments, due to the prolongation of the war and the enormous rise in the cost of transport overseas, have rendered this venture, for a time at any rate, extraordinarily profitable. It is understood that sandalwood distillation was also under enquiry in the Forest Research Institute, as the matter is of considerable interest to the Forest Departments of both Madras and Coorg; but the Economic Branch of the Institute was ill-equipped to undertake the preliminary investigations, and was further not in a position to carry them out on the scale necessary to create confidence and so warrant an investment of either public money or private funds in the establishment of the industry.

The Forest Department has considered the possibility of utilising tan stuffs, and the Inspector-General proposes the appointment of an expert for tans and dyes. Work is, however, already going on in connection with the organisation for improving the tanning industry under the Indian Munitions Board, for the preparation and testing of tannin extracts on a commercial scale ; and this close connection between the laboratory and the tannery seems to be the correct method of tackling the problem.

Conclusions.

67. Although there is much that can be done by the Forest Research Institute in discovering possible products of value, in obtaining and disseminating information regarding their distribution and quality, and in testing them in the laboratory, it seems clear that an organisation of a different nature is required to ascertain the results of treating them under commercial conditions. It is not necessary that this organisation should be attached to the Research Institute or even in all cases be managed by the Forest Department, so long as the necessary touch can be maintained. It is here, we consider, that Departments of Industries will be able to co-operate with the Forest Department, either by establishing pioneer factories, or, where these are not necessary, in placing the data obtained by the research officer before the industrialist in a way which will elicit his support. In other cases, the suggestions put forward by the Forest Research Institute might be taken up by other suitable departments or by private agency direct.

Necessity of plantations.

68. There are certain special industries such as the manufacture of pencils, matches, tea boxes, both ordinary and three-ply, and packing cases, which require a continuous supply of suitable timber within a reasonable distance from the factories, this distance depending on the method of transport. As the species suitable for these industries do not as a rule occur gregariously, their concentration in plantations is strongly to be recommended. We understand that the Forest Silviculturist and local officers are engaged in studying the habits of these species, and that the formation of such plantations has been commenced in Bengal and Assam. Similar measures have been very effective in the case of fuel plantations of casuarina on the east coast and elsewhere in Madras, where the example has been largely followed by private enterprise. We have dealt further with a particular aspect of this subject in Chapter VI, where we discuss the various sources from which power can be provided for industrial purposes.

Fisheries.

Indian fisheries and their development.

69. Striking evidence was also put before us regarding the immense future which awaits a more active development of Indian fisheries. It has been abundantly demonstrated by the few investigations that have hitherto been conducted in Madras and Bengal into the possibilities of deep-sea fisheries, by trawling, netting or line fishing, that a very large supply of food can be obtained from this source. The dearness and irregular supply of fish in many cities and towns within a reasonable distance from the coast is a subject of general complaint. The fishermen are usually men of low caste, ignorant, idle and uneducated, with a low standard of comfort. They are mercilessly exploited by middlemen, whose exactions lessen the supply of fish and add greatly to its cost. In inland waters, various causes, such as the use of certain types of nets and fish traps, and the destruction of fish by the periodical emptying of irrigation channels, have had a most injurious effect on both the quantity and the quality obtainable.

Work of Madras Fisheries Department.

70. The Madras Fisheries Department has shown that much can be done to improve the methods of sea fishermen in drying fish and preparing fish oil and fish manure. As a result of its exertions, some 250 small fish-oil factories have been established along the coast, mainly by the fishermen themselves; and still further improvements in the preparation of the oil have been worked out by Sir F. Nicholson, the Honorary Director. The possibility of preparing tinned and cured fish of high quality has been amply demonstrated on a commercial scale. Co-operative societies have been started among fishermen, and seem likely in course of time to prove both successful in themselves and valuable in developing a sense of self-respect and a higher standard of comfort among their members. Much experimental work has also been done in connection with the stocking of tanks, rivers and canals with fresh-water fish, and the cultivation of certain species in lagoon waters offers very promising prospects. We think that the Fisheries Department deserves even fuller support from Government, especially in the further development of deep-sea fishing. The capture, preservation and transport of deep-sea fish require investigation and demonstration on a commercial scale. An organisation for the marketing of the fish will also have to be provided. Owing to the present uncertainty of the results and the various difficulties interposed by the strong position of middlemen, the absence of refrigerating storage and other causes, there are many obstacles to overcome, and private enterprise is not likely to enter this field, until Government has fully shown the possibilities of the industry and expert employés are available. The only attempt of which we heard to establish a private industry in fish on modern lines in this province, met with disaster owing to ignorance of local conditions, and the example is likely to prove deterrent unless Government leads the way.

The superior staff of the Madras Department consisted in 1917, in addition to the Honorary Director, of two Europeans, the marine and piscicultural experts, and three Indians, an oil and soap chemist, an assistant to the piscicultural expert and an Assistant Director, a highly educated Indian gentleman, himself of the fisherman caste, with European scientific training. The extension of the operations of the department will, it may be expected, lead to the training of a number of additional experts, whom private companies, when formed, will no doubt be glad to engage. The total expenditure on the department in 1915-16 was Rs. 1,83,000, against receipts of Rs. 1,35,000; the bulk of the latter, however, were payments in respect of certain fishing rights which the department administers.

Fisheries in other provinces.

71. The Bengal Department of Fisheries, which was till recently under the control of the Director of Agriculture, has at its disposal an amount less than

a quarter of that expended in Madras, and employs only a European piscicultural expert and two Indians. The work of the department has hitherto consisted mainly of a general enquiry into the conditions of fish life and fisheries in Bengal and Bihar and Orissa; a few co-operative credit societies have been started, and various special enquiries have been made: but the impression left on the Commission was that the department was seriously in need of staff and funds, and that little satisfactory progress was likely on existing lines. There is no reason to believe that the possibilities in Bengal waters are in any way inferior to those which the Madras department has shown to exist; but in Bengal, as in Madras, the fishing industry is carried on under very bad conditions. Organised private enterprise has not so far taken up the industry with any success, and the department appears to be out of touch with what little exists. We are very decidedly of opinion that the development of fisheries in Bengal should be taken up fully and energetically, and that the executive staff of the department should be considerably improved and strengthened.

We may remark that the Bombay and Burma Governments do not possess any Departments of Fisheries; and we would suggest that they might well consider the desirability of establishing them. The latter Government in particular draws a revenue of some Rs. 30 lakhs from fisheries.

Conclusions.

72. We see no necessity at this stage to propose the creation of an imperial Department of Fisheries, but we think that the proposals that we are making regarding the organisation of scientific services will have a most important bearing on the improvement of fisheries in India. To furnish each of the larger provinces with the necessary complement of scientists would involve undue expense, and an incomplete equipment would be useless; moreover, there are several large river systems which extend into two or more provinces, and the fish which frequent them cannot be studied satisfactorily by a purely provincial organisation.

We therefore recommend that the Zoological Survey be strengthened by the addition of scientific ichthyologists who would work in close touch with, and would occasionally be lent to, provincial departments. In this way they would soon accumulate a store of knowledge regarding the life histories and habits of Indian fish, in the absence of which much of the work hitherto done has been, and must remain, ineffective.

CHAPTER IV.

INDUSTRIAL DEFICIENCIES OF INDIA.

Incompleteness of India's industrial equipment.

73. The sketch of Indian industrial conditions outlined in the preceding chapters would be misleading, unless we drew attention to the extraordinary extent to which the country, with its great industrial possibilities and requirements, is dependent upon outside sources of supply for the raw materials and manufactured articles necessary in the daily life of a modern civilised community. The existence of these deficiencies is prominently before industrialists and consumers alike at the present moment, and before presenting a list of them, we may briefly discuss their causes.

Causes of deficiencies

74. The basis of modern organised industries in those countries where they made their first appearance, was the manufacture of cast and wrought iron. The invention of the steam engine created the necessity for machine tools, to produce parts which would fit with sufficient accuracy to give smooth and efficient working. The existence of machine tools greatly facilitated the manufacture of standardised parts in large quantities, which were in demand for the mechanical processes required in textile and other similar industries. These large-scale manufactures increased the demand for industrial chemicals.

But the course of industrial development in India has followed very different lines. The political and economic conditions of India in the past have created a large export and import trade; and this trade has brought about the present industrial position. A large railway system and such other mechanical facilities as were necessary for the preparation and transport of produce for export have been brought into existence, but, in the absence of an existing iron and steel industry, with imported appliances. The great textile industries similarly rely almost entirely on imported plant and spares. The obvious need of having repairs done on the spot has led to the establishment of numerous engineering shops, without any corresponding equipment for actual manufacture.

The Indian iron and steel industry.

75. An examination of the present position of the Indian iron and steel industry will show how the deficiency in this all-important industrial factor has affected the general situation.

Pig iron has been continuously produced in India since 1875, but it was only in 1914 that the steel industry was established on a firm basis; and since the outbreak of war, the capacity of the plant has been strained to the utmost to meet urgent military demands. There has, therefore, been no opportunity as yet to gauge the results which must inevitably follow this important industrial advance, made at an extraordinarily opportune moment for India.

The imports of iron and steel in 1913-14, including galvanised iron, tin plates, steel sheets and plates, constructional iron work and railway plant, amounted to over 1,250,000 tons valued at 25 crores of rupees. In addition to these, there were large imports of manufactured iron and steel in the form of machinery and millwork, motor cars and under other heads. The total capacity of the two large Indian iron works is only a fraction of the total amount imported, and only simple forms of steel, such as rails and other rolled sections, are produced. The war has given a stimulus to extension, and the schemes now under consideration will undoubtedly result in an early increase in the volume of outturn and in a wider range of marketable products.

Imports of machinery.

76. The following brief statement of certain types of machinery imported by sea in 1913-14, the last year of peace conditions, will further illustrate the position :—

Articles.	Value. Rs.
Prime-movers	83,03,895
Electrical machinery	51,79,440
Agricultural machinery	2,65,335
Boilers	35,54,205
Metal-working machines	1,45,965
Oil-crushing and refining plant	3,21,870
Paper-mill plant	3,48,975
Rice and flour mills	15,99,180
Sewing machines and spares	40,70,055
Sugar machinery	4,67,325
Tea machinery	21,33,570
Textile machinery—	
Cotton	1,78,75,425
Jute	1,45,70,235
Others	3,53,820
Typewriters and spares	11,32,995
Miscellaneous items	1,33,11,180

The imports of boilers and prime-movers are due to the absence in India of a complete system of engineering industries, based on the large-scale manufacture of iron and steel. The lack of familiarity with the use of machinery among the people generally accounts for the fact that, though India's greatest industry is agriculture, the demand for agricultural machinery is limited to the products of a few small local manufactures, supplemented by imports valued at about Rs. 2½ lakhs. India produces more than 3,000,000 tons of raw sugar per year, and in addition imports manufactured sugar to the value of Rs. 15 crores, yet the value of the sugar machinery imported was only a little over Rs. 4½ lakhs. Similarly, oil seeds worth nearly Rs. 25 crores were exported ; but oil-crushing and refining plant to the value of only Rs. three lakhs was imported. With paper and pasteboard imports worth Rs. 160 lakhs, paper-mill machinery and plant worth only Rs. 3½ lakhs were imported. These figures are significant of the exiguity of the efforts hitherto made in India to replace imported articles by the manufacture of indigenous raw materials. On the other hand, the very large value of the imports of machinery for the textile industry is due to the entire absence in India of any engineering works capable of supplying her needs, and the consequent reliance on overseas sources for this all-essential need of our largest existing industry. The direction of Indian industrial development has been thus predetermined by the existence of a large export trade in raw materials, and by the ease with which most classes of manufactured articles could be imported from abroad. Other factors arising to some extent out of this general tendency, have helped to restrict Indian industrial progress in the past to an incomplete and limited development along the lines already indicated.

Shyness of capital for modern enterprises generally.

77. Where money has been invested in industries, it has generally been confined to a few simple and safe enterprises of an obviously attractive nature, whilst equally important minor industries have been almost entirely neglected, partly through ignorance of the country's resources in raw materials, but

mainly because commercial firms have prospered too well along conservative and stereotyped lines to trouble about undeveloped industries with uncertain prospects. Before the war, they could always be sure of importing all necessary stores and machinery of assured and regular quality, and they have naturally preferred a safe profit from trade, or from such established industries as jute and cotton manufacture, to a doubtful return from such ventures as metallurgical and chemical manufactures. Another contributory cause has been the practice pursued by Government departments of indenting on the India Office for miscellaneous stores, which has been to some extent due to the absence of a stores-purchasing department in India. Government rules intended to encourage the purchase of locally manufactured articles have not succeeded in counteracting the tendency of indenting officers to place on some recognised authority the responsibility for price and quality.

Generally speaking, the industries based on technical science have been disregarded, because profits in other ways have been easy and assured. The neglect of applied science is perhaps the most conspicuous among our administrative deficiencies.

Deficiencies in industrial system.

78. We have dealt in greater detail in Chapter X with the corresponding dependence of India on imported technologists and engineers. It was to this aspect of the question, as well as to the economic loss caused by importing articles which could be manufactured in India, and to the absence of Indian capital and management in many existing industries, that the attention of those who urged the need for industrial advance was principally directed before the war. The incompleteness of our existing system of industries has been subsequently brought into prominent notice by the interference with industrial supplies from overseas due to the war. This constitutes a serious national danger, the extent and gravity of which will be the more clearly realised, if we refer in detail to some of the more important manufactured *materials* or *articles* which are not at present made in India, although the basis for their production exists in the form of raw material.

Deficiencies in manufactured materials.
(a) Metals.

79. We have already referred to the position of the iron and steel industry. In the case of the non-ferrous metals, the Bawdwin mine, situated in the Northern Shan States of Burma, contains sufficient lead and zinc to meet in full the demands of India for these metals; but as yet only metallic lead is smelted, and, before the war, a small proportion of the zinc ores was exported to Germany and Belgium, and afterwards to Japan. These ores are not only valuable for their metallic contents, but are capable of yielding large quantities of sulphur; and the establishment of zinc-smelting works, with recovery of the sulphur in the form of sulphuric acid, is a step which is absolutely necessary in the interests of existing and future chemical industries, and is likely to be undertaken within the next two or three years. At present, India does not actually produce refined copper, although the Cape Copper Company has already begun smelting for blister and will shortly place refined copper on the market. The plant of this company has a capacity of 1,000 tons of refined copper per annum, which is, however, equivalent to a small fraction only of the imports. These, in the form of brass, yellow metal, copper sheets, copper wire and miscellaneous manufactures, amounted yearly to over 37,000 tons, valued at Rs. 411 lakhs. In addition, nearly 1,300 tons of German silver, an alloy of copper and nickel, were imported worth over Rs. 22 lakhs.

India is apparently well supplied with bauxite as a source for aluminium; but until hydro-electric energy is procurable at a cost low enough to permit of smelting under economical conditions, the metal cannot be produced in this country. We believe that one or other of the hydro-electric schemes projected on the Western Ghats will be able to supply electricity at a sufficiently cheap rate, and it is desirable that Government should facilitate the institution of suitable schemes.

Until 1914, the manufacture of tungsten powder was practically confined to Germany, though, since the outbreak of war, it has been carried on in the United Kingdom. Unless tungsten is smelted in India, we shall be unable to produce ferro-tungsten and "high-speed" steel, which are almost essential requirements in modern engineering shops. They are made by highly specialised manufacturing processes, which can be successfully introduced into India only with the help of some existing company already engaged in the industry and in full work. No use is at present made of Indian chromite in the country for metallurgical, and very little for chemical, purposes. Ferro-manganese has recently been produced in India, but for other ferro-alloys required in the manufacture of special steels, we are dependent upon imported supplies. Most of these can be produced only, or at any rate most suitably, in an electric furnace, which can be worked economically on a relatively small scale. The immediate want, as in the case of ferro-tungsten and aluminium, is a supply of cheap electric power. Indian graphite, in most occurrences, is impure, but Ceylon graphite can easily be imported. We do not, however, manufacture graphite crucibles, a necessity in various metallurgical and other industries. India is the principal source of mica of the highest grades, but, in the absence of any manufacture of electrical machinery, it has to be exported at present in a practically raw state. We have in the Travancore monazite a large supply of incandescent earths suitable for the manufacture of gas mantles, but owing to our inability to manufacture thorium nitrate in this country, the mineral is exported in the form of concentrates.

(b) Chemicals. India imports chemicals to the value of more than a crore of rupees a year; but owing to the great variety and the relatively small quantities of each kind consumed in India under peace conditions, local manufacturers have hitherto limited their attention to the few "heavy" chemicals which were in sufficient demand to support an economic unit of manufacture, and, as in the case of acids, were protected by heavy sea freights. Simple drugs and extracts are also manufactured on a small scale, but only in official medical stores and a few private factories on any recognised standard of purity and strength. Though improvement has been effected under war conditions, much still remains to be done before we exhaust the possibilities of these important products in this direction. We have already referred to the dependence of India on outside sources for sulphur, and to the necessity of insisting on the local smelting of her sulphide ores. In the absence of any means for producing from purely Indian sources sulphuric, nitric and hydrochloric acids, and alkalis, our manufactures, actual or prospective, of paper, drugs, matches, oils, explosives, disinfectants, dyes and textiles are dependent upon imports which, under war conditions, might be cut off. Sources of raw materials for "heavy" chemicals are not deficient. The output of saltpetre could be raised to 40,000 tons per annum, and supplementary supplies of nitrates could be produced, if necessary, from atmospheric nitrogen; but for this again, cheap electric power is needed. Salt occurs in abundance, and the establishment of caustic soda manufacture, preferably by an electric process that would also yield chlorine, is a necessary part of our chemical programme. There are available in the country, in fair quantity, many other raw materials necessary for "heavy" chemical manufacture, in addition to those referred to under other heads: among them may be mentioned alum salts, barytes, borax, gypsum, limestone, magnesite, phosphate of lime and ochres. The installation of plant for the recovery of by-products in coking has recently been undertaken, but for the recovery of tar and ammonia only. The recovery of benzol and related products has so far not been attempted, nor has anything been done to utilise the tar by re-distillation or other chemical treatment.

(c) Vegetable and animal products.

Although India exported raw rubber valued in 1917-18 at 162 lakhs, rubber manufacture has not been started in the country, and goods to the value of 116 lakhs were imported in 1917-18. This industry is one of those that are essential in the national interest and should be inaugurated, if necessary, by special measures. Though textile industries exist on a large scale, the range of goods produced is still narrow, and we are dependent upon foreign sources for nearly all our miscellaneous textile requirements. In addition to these, the ordinary demands of Indian consumers necessitate the import of some Rs. 66 crores worth of cotton piece-goods, and interference with this source of supply has caused serious hardship. Flax is not yet grown in appreciable quantities, and the indigenous species of so-called hemp, though abundantly grown, are not at present utilised in any organised Indian industry. Our ability to preserve many of our foodstuffs in transportable forms, or to provide receptacles for mineral or vegetable oils, depends on a supply of tin plates, which India at present imports in the absence of local manufactures. Our few paper factories before the war stood on an uncertain basis, and we are still dependent upon foreign countries for most of the higher qualities. India produces enormous quantities of hides and manufactures certain qualities of leather on a relatively small scale by modern processes; and the village tanner supplies local needs only, and with a very inferior material. To obtain the quantities and standards of finished leather which the country requires, it will be necessary to stimulate the industry by the institution of technical training and by experimental work on a considerable scale. This subject is treated at some length in Appendix D. Large quantities of vegetable products are exported for the manufacture of drugs, dyes and essential oils, which, in many cases, are re-imported into India. Some efforts have recently been made to lessen this obvious waste, but, in the absence of a sufficient botanical and chemical staff, it has hitherto proved impossible to open up the very important and profitable field of industry which indubitably awaits development in this direction.

Other deficiencies.

80. India's defective industrial equipment is further exemplified by imports of cement valued at Rs. 66 lakhs, soap at Rs. 75 lakhs, and paints at Rs. 64 lakhs. The manufacture of these materials has for long been established in the country, and has been appreciably increased since the year 1913-14, but the extent by which it falls short of the requirements of the country is fully evident.

Deficiencies in the production of articles.

81. So far we have considered only the case of manufactured *materials*, but these are in many cases of little use, unless they can be converted into *articles* of industrial or domestic value, and Indian manufacturers have in the past confined themselves to a very small number of these, which seemed to promise certain and large profits. The blanks in our industrial catalogue are of a kind most surprising to one familiar only with European conditions. We have already alluded generally to the basic deficiencies in our iron and steel industries, and have explained how, as a result of these, the many excellent engineering shops in India are mainly devoted to repair work, or to the manufacture, hitherto mainly from imported materials, of comparatively simple structures, such as roofs and bridges, wagons and tanks. India can build a small marine

engine and turn out a locomotive, provided certain essential parts are obtained from abroad, but she has not a machine to make nails or screws, nor can she manufacture some of the essential parts of electrical machinery. Electrical plant and equipment are still, therefore, all imported, in spite of the fact that incandescent lamps are used by the million and electric fans by tens of thousands. India relies on foreign supplies for steel springs and iron chains, and for wire ropes, a vital necessity of her mining industry. We have already pointed out the absence of any manufacture of textile machinery, and with a few exceptions, even of textile-mill accessories. The same may be said of the equipment of nearly all industrial concerns. The list of deficiencies includes all kinds of machine tools, steam engines, boilers, oil and gas engines, hydraulic presses and heavy cranes. Simple lathes, small sugar mills, small pumps and a variety of odds and ends are made in some shops, but the basis of their manufacture and the limited scale of production do not enable them to compete with imported goods of similar character to the extent of excluding the latter. Agriculturists' and planters' tools, such as ploughs, *mamooties*, spades, shovels and pickaxes are mainly imported, as well as the hand tools of improved character used in most cottage industries, including woodworking tools, healds and reeds, shuttles and pickers. Bicycles, motor cycles and motor cars cannot at present be made in India, though the imports under these heads were valued at Rs. 187 lakhs in 1913-14. The manufacture of common glass is carried on in various localities, and some works have turned out ordinary domestic utensils and bottles of fair quality, but no attempt has been made to produce plate or sheet glass, or indeed any of the harder kinds of commercial glass, while optical glass manufacture has never even been mooted. The extent of our dependence on imported glass is evidenced by the fact that in 1913-14 this was valued at Rs. 164 lakhs. Porcelain insulators, good enough for low tension currents, are manufactured, but India does not produce the higher qualities of either porcelain or china. Attention has been directed to the building of steel ships, but until the local supply of steel has been greatly increased, it is more than doubtful if expectations in this direction can be realised, and it is probable that there are other ways in which our present relatively small supplies of Indian steel can be more quickly and more profitably utilised.

Dangers of deficiencies.

82. The list of industries which, though their products are essential alike in peace and war, are lacking in this country, is lengthy and almost ominous. Until they are brought into existence on an adequate scale, Indian capitalists will, in times of peace, be deprived of a number of profitable enterprises; whilst in the event of a war which renders sea transport impossible, India's all-important existing industries will be exposed to the risk of stoppage, her consumers to great hardship, and her armed forces to the gravest possible danger.

Suggested remedies.

83. The removal of these deficiencies is one of the main objects of our proposals, and the various schemes which we set forth are designed to meet this end, as well as to promote the industrial prosperity of the country generally. We desire, however, to draw attention here to the necessity of securing the inception in India of certain very specialised and essential industries, which must be set up in this country at the earliest possible date, if grave dangers are to be avoided. Though in many cases the importation of technical specialists will be sufficient to enable our local industrial capitalists to get to work, there are a few classes of articles produced only by firms which have attained efficiency in their manufacture after the experience of many years

and the expenditure of much money. The machinery and apparatus which they employ is often manufactured only by themselves or to their own specifications, and its imitation in this country is not possible, nor, were it possible, would this be sufficient. Therefore, to attain its end, Government must take special steps to facilitate the manufacture of these articles in India. Among such industries, we would include the production of such essential articles as magnetos, incandescent lamps, ferro-tungsten, "high-speed" steel, graphite crucibles, special forms of porcelain for insulators, chemical glass, and probably also certain forms of "heavy" chemicals, rubber and vulcanite. In other countries, foreign firms have frequently been encouraged to start branches by the existence of high tariff walls; there are also somewhat numerous examples of direct encouragement accorded to the establishment of foreign firms manufacturing lethal munitions; and we believe that there are several cases in which outside manufacturers have been helped to set on foot the production of articles needed in the interests of national safety, such as motor tyres and locomotives. There are many other important manufactures which, though they must be carried out on a large scale, involve no secret processes that any well-trained specialist should be unable to initiate; and, in the inception and stimulation of this large range of important industries, the organisation which we propose and the efforts of private industrialists will be more than fully occupied for a long time to come.

CHAPTER V.

INDUSTRIES AND AGRICULTURE.

Importance of agricultural improvements.

84. It will be clear from the general trend of this report that the present position and future prospects of Indian industries depend to a very large extent on the products of Indian agriculture. We take this opportunity of stating in the most emphatic manner our opinion of the paramount importance of agriculture to this country, and of the necessity of doing everything possible to improve its methods and increase its output. We consider the improvement of agriculture necessary, not only because it forms the basis on which almost all Indian industries must depend, but also for the further reason that the extension among the people of a knowledge of improved agricultural methods, and, in particular, of the use of power or hand-driven machinery, will benefit agriculturists both by adding to their income and by its educative effect.

Such improvements will, we anticipate, be mainly effected by organisations which are in process of development under the charge of the imperial and provincial Departments of Agriculture, and though the results attained are not yet of much economic importance, they are steadily growing, and will eventually demand large manufacturing establishments to produce the machinery, plant and tools which the ryot will find advantageous as labour-saving devices.

Agricultural progress will inevitably be followed by a general rise in the standard of living, which will create a much larger demand for manufactures than now exists, and thus provide within the country a market for the products of the increased industrial activity which our proposals are designed to ensure.

It is obvious, therefore, that the efforts of Government for the improvement of agriculture should be made *pari passu* with those which it may adopt for the improvement of industries, as the result of the recommendations in this report.

Possibilities of improved agricultural methods.

85. We have drawn attention in Chapter III to the large proportion of Indian products which are exported in an unmanufactured condition. The improvement of agriculture will no doubt increase the volume of such products raised in India; but it is far from likely that the result of this will be a proportionately greater export of raw produce. The increase of capital, the rise in wages, and the economic education of agriculturists, which will result from agricultural improvement, are all factors which are likely to assist industrial development. To take one example, sugar is an important item of the food supply of the people of India, and one reason why such a large quantity is at present imported, is the want of adequate means for familiarising Indian farmers with the principles of scientific agriculture and for putting them in a financial position to take advantage of these. It is scarcely conceivable that a similar state of affairs should arise with regard to any other food product of equal or greater importance; but the instance of sugar is, at any rate, significant of a state of affairs into which a country, which neglects agricultural improvement, may easily drift.

The Indian Famine Commission, 1880, pointed out that "the numbers who have no other employment than agriculture are in large parts of the country greatly in excess of those required for the thorough cultivation of the land." In the forty years which have elapsed since this was written, there has been some change for the better, but it is still strictly true that there is a vast field for improvement in the efficiency of the methods and, still more, of the implements employed by the ryots. It is well known that, in many cases, the yield per acre of Indian crops is very much lower than that obtained in other countries. The average weight of stripped cane per acre in the principal sugar-producing tracts of India is only ten tons against forty tons in Java. In India 98 pounds of ginned cotton are obtained per acre; in the United States nearly 200 pounds; and in Egypt 450 pounds. The average yield of rice per acre is only about half what it is in Japan. India cannot, however, claim to set off against the lower yield a greater economy in the use of her available labour.

Scope for machinery in Indian agriculture.

86. In British India, the area under cultivation is approximately 250,000,000 acres, of which 40,000,000 acres are, for the time being, fallow and unworked. The Census Returns of 1911 show that of the total population, 80,000,000 are directly employed on the land, or one person to every 2·6* acres of cultivated land. Previously to the outbreak of war, the corresponding figures for Great Britain and Germany were one to 17·3 and one to 5·4 acres, respectively. The only crops grown in both England and India on a large scale are wheat and barley; the respective standards of yield are 1,919 lbs. and 814 lbs. per acre for wheat, and 1,645 lbs. and 877 lbs. per acre for barley. It becomes, therefore, regrettably clear that agricultural operations are conducted with much greater efficiency and economy of human labour in both Great Britain and Germany than they are in India. This is partly due to the superior physique and education of the cultivators themselves, partly also to the superior quality of their cattle, but it very largely results from the extensive employment of horse and motor-driven machinery in the varied operations of a modern farm, such as ploughing, reaping and threshing. The census of production of 1908 revealed the fact that the farmers of Great Britain in that year employed nearly 35,000 engines, developing well over 200,000 horse power, and it cannot be doubted that since that date the use of small motors and power-driven tractors has greatly increased, as agricultural engineers both in Europe and America have devoted much time and labour to devising improved machinery of this class. In India, agricultural conditions are widely different; but there is an equal, if not greater, scope for mechanically operated plant. As yet, very little is in use, chiefly because holdings are small and scattered, and ryots possess little or no capital. The co-operative movement may be expected to promote combinations to secure some of the advantages of farming on a large scale, and these would be greatly stimulated by the grant of *takavi* loans for the purchase of labour-saving machinery. Attention will be drawn to the results achieved in this direction in the south of India—not very important perhaps, if measured by their immediate economic effect, but of great value as indicating the line along which development may be pursued with certain prospects of success.

87. Power-driven machinery may be very largely employed in India in connection with agriculture :—

(1) to lift water for irrigation from wells, channels, tanks, watercourses and rivers;

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* Fallows have been excluded in the case of India and included in the case of Great Britain and Germany. In India, fallows are due, as a rule, to accidental misfortune, or to land being on the very margin of cultivation. Fallow land in India is entirely neglected; in England and Germany it is kept clean and well cultivated as a regular feature of agricultural practice. Meadows and grass lands have been included in all three cases, though they are carefully treated in England and Germany, and receive little or no attention in India.

(2) to improve the land by draining low-lying ground and water-logged soil and keeping down the level of saturation in canal-irrigated tracts; and in certain parts of the country, by deep ploughing;

(3) to prepare crops for the market in the most profitable form. This includes such operations as fibre and oil extraction, wheat grinding, paddy husking, coffee pulping, tea manufacture, and, most important of all, sugarcane crushing, a subject which will be dealt with in more detail below;

(4) to prepare materials required in agriculture, such as bone meal for manure, and crushed or chopped cattle food.

Scarcely less important, both as an educative influence on the cultivator and as a means of improving the efficiency of agricultural labour and the quality of the produce, is the provision of hand machinery of improved types, especially for the reaping, threshing and winnowing of crops, and the preparation of food and fodder; also of modern plant and implements worked by animal power, to cultivate the land or drive small machines. Further, these will also serve as an easy introduction to the use of power-driven machinery proper.

Irrigation by mechanical methods.

88. We cannot do more than indicate very roughly the extent to which the development of irrigation by mechanical methods may ultimately be carried, and the following observations are only intended to convey some notion of what is possible. There are at least three million wells in India from which water is lifted for irrigation, and the number of men and cattle employed on this work is very large. The Indian Irrigation Commission of 1901-03 reported that the area under wells was not less than 16 million acres, and they remarked :—"It may not be sanguine to look forward to a period when the area under well irrigation throughout India will have been doubled." Since this opinion was expressed, mechanical methods of lifting water from wells and rivers have been greatly developed, and the depth from which water can now be profitably raised is at least twice what it was 15 years ago. This enormously increases the volume of underground water which can be tapped, and consequently the area which might be brought under irrigation. Within the last few years, fully 1,000 pumping stations have been established in the south of India, and the number is large enough to warrant the general conclusion that mechanical methods of lifting water for irrigation can be applied in India on a very extended scale. Even if in no more than five per cent. of the wells now used for irrigation the use of small mechanically driven pumps were practicable and the area under well irrigation developed to the extent the Irrigation Commission anticipated, this would mean the employment of about 300,000 pumping sets at an initial capital outlay of something like 50 crores of rupees, with annual working expenses of probably not less than six crores, and with the result of very large gains to the cultivators. The manufacture of this immense amount of plant, with adequate provision for renewals and repairs, should give employment to many large mechanical engineering establishments, which would undoubtedly grow up to supply so vast a market. Steam, oil, gas, and petrol engines, and electric installations could all be appropriately used as sources of motive power, each on more or less standard lines, which would greatly facilitate their manufacture. Similarly, a great variety of pumps would be required, and for each there would be a large demand. Where conditions are favourable, central generating stations might be established and the motive power for driving the pumps distributed electrically, while incidentally the demand for belting would keep several large factories fully occupied.

Attention may also be drawn to the advantages of pumping water from rivers for irrigation. Both in Madras and Bombay, some work in this direction has already been done, and the Divi island plant on the Kistna river is probably the largest irrigation pumping station in the world. The total cost of this installation was 20 lakhs of rupees, and it now irrigates an area of 35,000 acres. There are many rivers, the perennial flow of which is by no means fully utilised, but could be made available, if lifted from the river beds by means of pumps. The possibilities of lift irrigation in Sind are unknown, but probably very great. The river Indus flows through the country and, by means of inundation canals, irrigates considerable areas during the flood season; but for the rest of the year the water flows uselessly into the sea. The project for the construction of a barrage across the Indus is still under consideration, and, if it be finally accepted as practicable, the work will be difficult and protracted. It seems that investigations should be made to ascertain the feasibility of irrigating the land by pumps in the meantime. Experimental work can be done at a very small cost and can be developed with great rapidity if successful. The possibility of growing Egyptian cotton in Sind can be thoroughly tested by a preliminary irrigation scheme of this type, and, if the results are promising, progress can be made with demonstration work in readiness for the barrage irrigation system.

Increased yields to be obtained from sugarcane cultivation.

89. In our note on sugarcane (Appendix C), we have drawn attention to the results likely to be obtained by the introduction of central power-driven cane-crushing plants. Each of these at pre-war prices cost about Rs. 12,000, and is capable of dealing with 100 acres of good cane in a season. Roughly, of the sugar consumed in India, three-fourths is grown in the country and one-fourth is imported. Roughly also, of that grown in the country, one-third is wasted owing to the inefficiency of the primitive methods of extraction. Nearly one-half of this loss might easily be avoided, and, if it were, the profits of cane cultivation would be greatly increased.

We have had much evidence brought before us to show that, under favourable conditions, sugarcane cultivation is very profitable and yields much higher returns than can be obtained from most other crops; but the average outturn throughout the country is exceedingly poor, and the area under cane cultivation depends upon, and varies with, the relation between the prices obtainable for sugar or *gur*, and those for such crops as paddy and *ragi*. The ryot's difficulties are want of water for irrigation, the strain imposed upon his cattle during the cane-crushing season and lack of capital. The pump will often help him over his first difficulty, and the engine will drive his mill and reduce the work thrown on the cattle to that of carrying the cane from the field to the mill, while the larger yield and the smaller expense in working will greatly increase his profits.

Years ago, the iron-roller mill replaced the wooden *charki*, and now the time has come when the power-driven mill should as completely replace that worked by cattle. The area under cane cultivation in British India is about 2½ million acres. Improvements in the methods of extracting the juice can certainly increase the yield by ten per cent., and it is equally certain that better cultivation and the more extended use of manure should add at least 20 per cent. to the gross weight of the crop, making the total increase in the amount of sugar produced in India 32 per cent., or more than sufficient to render the country self-supporting at the present time. The universal adoption of power plants for cane crushing would cost about 30 crores of rupees; this expenditure would be justified by the consequent reduction of the present cost of cane crushing and by the increased yield of sugar. The indirect gains to agriculture would also be of the highest importance. Large numbers of cattle, whose work must be equivalent to many hundreds of thousands, probably millions, of horse power, are employed in lifting water and crushing cane. It is hardly realised how heavy is the burden thus entailed upon the farmer's cattle, and how severe the resulting deterioration of their working power for purposes of cultivation.

It will, therefore, be seen that, even under the present conditions of Indian agriculture, an expenditure of 80 crores of rupees upon machinery for well irrigation and cane crushing alone would be highly remunerative, and it is probable that thereafter a further, and possibly greater, outlay would prove profitable. Rough figures only have been given to convey some idea of the scale on which operations might ultimately be conducted, but they suffice to show that in this direction alone a vast mechanical engineering industry and many others subsidiary to it would inevitably spring up throughout the country.

Improvements in oil extraction.

90. Oil seeds are grown on an average area of about 15 million acres in British India; a large proportion of the crop, valued at about 36 crores of rupees, is exported in normal years and the remainder consumed locally. The extraction of oil is practised to some extent wherever oil seeds are grown, chiefly by means of bullock-driven *ghanis*, which are neither efficient in expression nor economical in labour. Power-driven mills are found to some extent in Calcutta, Bombay and elsewhere, particularly on the west coast for the treatment of copra; but there is room for great extension of their use, especially for types of plant which will give a more complete extraction. This is perhaps of less importance in the case of oil seeds which yield cake for cattle food; but when the cake is used for manure, as in the case of castor seed, any oil left in it is wasted. Indeed it is probable that even in cake used for cattle food any excess of oil over five per cent. is wasted, and that, in all cases where edible cake is directly used as manure, any oil contents whatsoever are not merely valueless, but actually harmful. In recent years, the extraction of oil by continuously operated screw-presses has become more common; this process has proved very satisfactory in treating certain kinds of Indian seeds, and there is undoubtedly a large field for its employment. As in the case of sugarcane crushing, and for the same reason, it is desirable to eliminate cattle-driven mills and to employ more powerful and, therefore, more efficient means of extraction. At present, so large a percentage of the oil available from the seeds is left in the cake that there seems to be a fair prospect of successfully working the latter over again by solvent processes, which are capable of extracting the oil almost completely. This would be a great gain in the case of fertiliser cakes. But, as regards fodder cakes, the Indian ryot is not yet convinced that his cattle can only usefully assimilate a small proportion of the oil contained in the cake which he feeds to them, and, therefore, he still prefers to feed his cattle on cotton seed rather than on cotton-seed oil cake.

Effects of agricultural improvements on industries.

91. Even from the point of view of Indian industrial development, the necessity for increased efforts for the improvement of agriculture is clear. The ideal before the Department of Agriculture is the production of a larger output of more valuable crops, with smaller demands on human and animal labour. This will result in a greater creation of wealth and an increase in the raw materials for industries; will ease the difficult problem of the supply of cattle; and will liberate additional labour for industries.

Co-operation between Departments of Agriculture and Industries.

92. We may again emphasise the imperative importance of keeping the Department of Agriculture in close touch with modern developments connected with the generation of power. India is not yet at all accustomed to a free use of mechanical appliances, and it should be an important function of the Departments of Industries and Agriculture to encourage their introduction in every possible way. Experience in other countries is not directly applicable to India, and a special study of the local conditions is essential to rapid and sustained progress. The Director of Industries in each province should have a complete laboratory, equipped for the mechanical testing of small prime-movers. and the machinery that they are intended to drive. The requirements of the ryots should be studied, and any defects in the machinery should be carefully noted and communicated to the makers. For a long time to come, the employment of machinery in agricultural India will largely depend upon the completeness and efficiency of the official organisation which is created to encourage its use and to assist those who use it.

CHAPTER VI.

POWER.

93. The distribution of the natural resources for generating energy which a country possesses, mainly determines the location of, at any rate, those industries in which the cost of fuel for power and heat bulks largely in the total manufacturing charges.

Position of India in respect of power supplies.

In the mill and general engineering industries, fuel is chiefly required to generate power, and, though its cost is important, it is seldom the dominant factor. With sea transport available to coast towns, with the extended railway system which the country now possesses and with other sources of fuel-supply yet to be mentioned, no great difficulty appears to be experienced in any part of India in obtaining coal or some form of fuel, at what may be deemed a reasonable cost for ordinary power purposes. It may here be observed that the greatly increased efficiency of our methods of converting heat into work during the last 20 years has materially improved the position of India as a potential user of mechanical appliances, though the effect is not yet fully apparent, owing to natural reluctance to relegate to the scrap-heap obsolete but serviceable plant. Engines are in use which, though they are still mechanically in good condition, require much more steam than a modern engine of the same size. The institution, however, of certain important industries, for example electro-smelting and some electrolytic chemical processes, is possible only when power is available at rates well below the cost at which it can usually be obtained through the medium of heat engines.

Sources of Power Supplies.

94. As we have already seen, the distribution of coal in India is very irregular, being chiefly confined to the old province of Bengal, where the deposits are of great extent; to the Central Provinces and Central India, where the fields are only partially developed, and, so far as is known, contain only coal of an inferior description; and to the Hyderabad State, which possesses the Singareni field yielding a steam coal of fair quality.

Coal.

For metallurgical purposes the supplies of suitable coal are greatly restricted. The Tertiary coal of north-east Assam produces an excellent coke, but its situation naturally limits its use; there are also similar coals in some of the smaller Assam fields, like Daranggiri, which are not yet served by railways; but the only large supply of good coking coal so far established, and within an area suitable for industrial development on modern lines, is that of the Gondwana fields of Bengal and Bihar.

Even in these Gondwana coking coals, the high percentage of ash and correspondingly low calorific value reduce their radius of economic use under conditions of railway transport, and it will be still further diminished, as the shallow seams are exhausted and the deeper coal is worked at higher cost. The demands for coal from the Bengal fields are rapidly growing, and the metallurgical developments that are economically desirable or are necessary on the ground of military security, will increase the demand for the best qualities of coal to an extent that necessitates a special survey of the situation, with a view to introducing economies in the methods of mining and consumption. We recommend that this question be taken up at an early date. Such a review of the fuel situation in eastern India should include an examination of measures in progress for rendering more accessible the undeveloped fields of Assam.

The coals of the Central Provinces are generally characterised by high percentages of ash and moisture with correspondingly low calorific values. As sources of power, therefore, these coals have a limited sphere of utility, and being, so far as is known, unsuitable for coke making, their use is limited to steam raising.

Coal of Tertiary age, generally inferior in quality and limited in quantity, is obtained from small fields at Palana in the Bikanir State, in the Salt Range of the Punjab, in Jammu and in Baluchistan. These sources of supply are insufficient to meet the demands of industries conducted on anything approaching modern lines.

Wood fuel.

95. The forests are capable of yielding important supplies of wood fuel, which can be most advantageously employed, after conversion into gas, to generate power in internal combustion engines. Gas plants are obtainable which can be worked with the wood either in its natural state or after its reduction to charcoal. But we may observe, in passing, that the use of wood in steam boilers, when the steam is required for power purposes, is extremely wasteful and should be discouraged as much as possible. The forests of India are unfortunately confined chiefly to the hilly tracts, and over large areas the cost of transport of wood fuel is so heavy as almost to preclude its use. Further, the evidence we have gathered, chiefly from the officers of the Forest Department, does not encourage the idea that, even in the neighbourhood of the forests, the supply of fuel is capable of any very great expansion. Little or no information could be obtained regarding the rate of reproduction of fuel trees in natural forests, and the opinion was generally expressed that it would be necessary to have recourse to extensive planting to meet any heavy and continuous demands for wood fuel at reasonable rates. Only at Changamanga in the Punjab and in the south of India, chiefly in the neighbourhoods of Madras and Bangalore, have fuel plantations been at all extensively made. The results obtained from casuarina plantations along the Coromandel Coast have been very satisfactory, also those from the comparatively small areas on the Nilgiri Hills planted with eucalyptus.

We consider that the economic aspects of forestry in relation to the fuel supply of the country have hitherto not received sufficient attention. We desire to direct attention to the advantages of wood distillation as a method of obtaining charcoal and certain valuable by-products, acetate of lime, methyl alcohol and wood tar, by the sale of which the local cost of the charcoal would be greatly reduced. For all but the smallest units of power a suction gas plant is extremely convenient and efficient, and we recommend that any methods which are likely to cheapen the cost of fuel for such plants should be the subject of detailed investigation and trial.

Oil and alcohol.

96. There is no possibility of estimating the prospects of oil production, and it would therefore be unwise to rely on this form of fuel to make up for the depletion of our coal supplies. The serious economic value of the oil-bearing areas in Baluchistan and the Punjab is still far from being established as a commercial proposition; the oil field of north-east Assam has shown very slow expansion, and the value of the new fields at Badarpur in central

Assam has yet to be demonstrated. In Burma, the three main fields of Yenangyaung, Yenangyat and Singu are being rapidly exploited, and no others likely to replace them have so far been proved, in spite of extensive and costly prospecting operations.

It is very undesirable that the fuel supply of the country should be derived from external sources, and we were informed that in the Madras Presidency and Mysore, this aspect of the question had been considered by the Departments of Industries, whose officers now recommend the use of suction gas plants for all units of over ten horse power when charcoal can be obtained at a reasonable rate, and endeavour to confine the employment of the oil engine to power units below this size. Petrol is chiefly used in motor cars and small engines which are only intermittently employed. As a source of industrial power, it is unimportant; but the demand for it for other purposes is likely to grow, and the provision of a suitable substitute is generally recognised as desirable, if not actually imperative. On several occasions our attention was drawn to the possibility of making industrial alcohol from hitherto neglected vegetable materials, some of which appear to be sufficiently promising to justify investigation and experiment. We recommend that a more liberal policy should be followed by the excise authorities in respect of the class of denaturant prescribed, and more regard might be paid to the likelihood rather than to the mere possibility of frauds upon the revenue, when the requirements of commercial users conflict with excise regulations.

Wind power.

97. The value of wind power in India is very small, owing to the lightness of the prevalent winds, except along the sea coast and on the Deccan uplands. For industrial use this source of power is too intermittent and too uncertain, and it can only be employed with advantage for lifting water, either for domestic purposes or for irrigation. In the first case an elevated tank, in the other a storage reservoir is necessary; and only where these can be cheaply installed is it worth while to set up a windmill. Such mills are not common now, but the increasing cost of labour and the growing tendency to resort to mechanical appliances will probably lead to a more extensive use of them in the future.

Water power.

98. The principal reason why India has been able to develope water power only to a limited extent is that the seasonal character of the rainfall makes storage works in most cases a necessity, and the outlay involved in their construction, unless the water can be used for irrigation afterwards, is likely to raise the cost of power above the rate at which it can be generated by other means. The progress that has been made in the development of hydro-electric methods of generating and distributing electric energy has, however, opened out new prospects in India, which, in recent years, have been greatly enlarged by the investigations of engineers in the Bombay Presidency and the practical results which they have obtained. Before the electric transmission of power over long distances became a practical success, the use of water power in India was confined to one or two fairly large cotton mills, as at Gokak and Ambasamudram, to a number of small factories on planters' estates in the hills, and to numerous small water wheels on hill streams and at falls on the irrigation canals, which drive flour mills.

The Mysore Durbar set up the first central hydro-electric installation in India on the Cauvery river at Sivasamudram in 1903. Beginning with 4,000 horse power, the central generating station has been gradually enlarged, till at the present time its capacity is about 18,000 horse power, the major portion of which is transmitted at 70,000 volts over a distance of 90 miles to the Kolar gold fields. The irregular flow of the Cauvery has been overcome by the construction of a dam across the river at Kannambadi near Seringapatam, which stores sufficient water to maintain a minimum flow of 900 cubic feet per second. The Kashmir Durbar subsequently established a hydro-electric station on the Jhelum river near Srinagar ; but in this instance, the anticipated demand for power has as yet been only partly realised. In western India, attention was drawn to the potentialities existing in the heavy rainfall on the country fringing the Ghats and the facilities offered for the construction of hydro-electric installations by the very steep drop to the plains. After years spent in surveys and the preparation of plans, a company was formed with Indian capital, which has carried out a series of works in the neighbourhood of Lonavla, and these, though not yet complete, already supply the cotton mills in Bombay with 42,000 horse power for 12 hours a day. Additional works of a similar character, but on an even larger scale, are now being constructed in the Andhra valley, and are under contemplation in both the Nila Mula and Koyna valleys, though progress is greatly delayed by the war. The electric energy now supplied to Bombay is roughly equivalent to that which would be obtained from 600 tons of coal a day, and the reduction of the Bombay demand by this quantity is, under war conditions, a matter of great importance. It is expected that about half a million horse power will be obtained from the Western Ghats, which can either be transmitted to Bombay or utilised on the coast for electro-chemical industries, such as the extraction of aluminium from bauxite and the manufacture of nitrogen compounds from the air.

Elsewhere in India comparatively little use has been made of water power, though numerous cities and towns have been equipped with steam-driven electric installations for the supply of light and power. Undoubtedly the most important sources of water power immediately available are to be found in the streams and rivers draining the Himalayas ; but, except for the electric lighting of hill stations like Simla and Darjeeling, no profitable application of it has yet been discovered. The main Indian centres of population and industry, except Bombay, are situated at great distances from those parts of the country where the natural features exhibit possibilities for the generation of water power.

Necessity for hydrographic surveys.

99. The preliminary reconnaissances which have been made have yielded very little reliable information as to what can be done in the future. We now require hydrographic surveys on a much more elaborate scale than has hitherto been attempted. In view of the increased possibilities of water power due to the recent advances in electro-chemical and electro-metallurgical technology, these are now likely to produce results of practical importance. Large amounts of water power are in commercial use in other parts of the world for the manufacture of iron, steel, alloys, aluminium, calcium carbide and various nitrogen compounds. As we have elsewhere pointed out, it is imperative that some, if not all, of these industries should be established in India, and in order that they may be successfully worked on a commercial basis, the operations will have to be on a very large scale. In these industries the working cost is mainly made up of two items, the interest on the capital outlay and the cost of power consumed. They are essentially power industries, which can only be carried on where very large amounts of power can be obtained at rates below those usual in industrial centres. While for ordinary industrial operations a continuous supply of power throughout the year is essential, it may, perhaps, be practicable to shut down these highly specialised industries for two or three months in the year, during the period when the water supply is at its

lowest level. This would increase the number of probable sites for hydro-electric stations by diminishing the cost of storage works.

The storage of water for irrigation is well understood, and the general principles underlying its successful application have been thoroughly worked out. It is now necessary to reconsider the question of the storage and regulation of water, with the double object of power supply and irrigation. Irrigation engineers in recent years have not lost sight of this possibility, but are naturally still inclined to regard the power question as one of subsidiary importance, and are, therefore, unwilling to accept any compromises which would involve the sacrifice of irrigation to water power or interfere with their existing régime. Hitherto, prospecting for water power has not been recognised as an essential duty of the Public Works or any other Department, and, as already stated, very little has been done ; but the necessity for electro-chemical and thermo-electric industries alters the situation.

Reasons why Government should undertake this work.

100. We think it undesirable that the task of prospecting should be left entirely to private enterprise, as in the majority of cases such work could only be undertaken by strong financial syndicates, whose interests would not in some cases coincide with those of the public or of Government. For the following reasons, such work is more appropriately the function of a Government department:—

(1) Only Government can fairly estimate the effect of displacing an agricultural community, which would be the case in most reservoir schemes.

(2) Only Government can readily ascertain the land rights affected, and can adjust conflicting claims, especially where the storage area may be in one province, while the power site, through an accident of topography, may be in another, or even in a Native State.

(3) Only a Government department can afford to undertake the long-period gauging operations that are necessary, especially in the case of rivers like those of the Peninsula, which are subject to great seasonal variations.

(4) Unless a systematic hydrographic survey be undertaken by Government, it will be impossible to formulate precise rules for the grant of concessions, and private companies will, therefore, be compelled ordinarily to ask for exclusive privileges over large areas to forestall imitation and competition. Incidentally it is necessary that these rules should be sufficiently generous to attract private enterprise, without tying up for long periods areas that ought to be prospected, and without allowing large schemes to inhibit activity in the promotion of small local power schemes, or conversely small interests to preoccupy the choicest sites in neighbourhoods which might subsequently be found suitable for larger schemes of more general public utility.

(5) Only Government can initiate and carry through joint and interdependent power and irrigation schemes.

We, therefore, consider it necessary that Government should take in hand a systematic survey of the country to ascertain what hydro-electric possibilities exist, and we are of opinion that this should be started at once in view of the necessity of selecting, as early as possible, the best sites available for certain power industries. Delay to determine the resources of the country in this direction may involve much expenditure which might be avoided with the help of a previous survey. In the absence of adequate data, we refrain from expressing an opinion on the question of the agency to be employed in carrying out such works. The analogy of the Irrigation Department suggests that, when the power is distributed over wide areas and to many consumers, the work should be undertaken by Government ; but in other cases, such as the establishment of metallurgical or chemical works by private agency, a single consumer may be granted concessions to enable him to create his own water power. Leases of water power should provide for the resumption or transfer of rights and for the acquisition of the hydro-electric plant on an equitable basis, should it become necessary in the public interest, or should the initial industrial undertaking be compelled at any time to cease working.

Proposals for generating water power from canal falls and other irrigation works should be considered by a joint committee composed of officers of the Public Works and Industries Departments, so that conflicting interests may be adjusted as far as possible, and the utilisation secured of any sources of power which now exist or can be created.

CHAPTER VII.

THE INDIAN IN INDUSTRIES.

The share taken by different classes of Indians in industrial development.

101. We may now examine further the part played by Indians of all classes in the industrial development of the country, in order to ascertain the lines along which this tendency may be further stimulated. In a subsequent chapter we deal with the conditions under which factory labour lives, and show that these are in the highest degree antagonistic to any improvement in efficiency. These conditions are not easy to alter ; but it is obvious that the great obstacles are the lack of even vernacular education and the low standard of comfort. The higher grade of worker, the mechanical artisan, in the absence of adequate education has also been prevented from attaining a greater degree of skill. He finds himself where he is, less by deliberate choice than by the accident of his obtaining work at some railway or other engineering shop, or by the possession of a somewhat more enterprising spirit than his fellows. There is at present only very inadequate provision for any form of technical training to supplement the experience that he can gain by actual work in an engineering shop, while the generally admitted need for a more trustworthy and skilful type of man is met at present by importing chargemen and foremen from abroad.

Traders, employers and financiers differ very widely throughout the country in efficiency and in the degree of success which they attain. This must be ascribed to the fact that, in the absence of a proper system of industrial education and a considered policy of encouragement to industries, hereditary predisposition and the influence of surroundings have been left to produce their inevitable effect. The castes which exhibit the highest degree of intelligence are, with few exceptions, those whose functional characteristics have in the past been religious leadership, government service, or trade, and it is from these that the leading Indian industrialists, financiers and merchants have hitherto been mostly drawn. Though the representatives of these classes have attained a high degree of success in Bombay and Gujerat, and though there are numerous instances of successful Indian industrial enterprise in other parts of the country, Indian capitalists generally have followed their ancestral tradition of rural trade, and have confined themselves to the finance of agriculture and of such industries as already existed. When communications were improved and India was brought into effective touch with the outside world, traders took advantage of the changed position merely to extend the scale of their previous operations. Like the landlords, they lent money to the cultivators and found a profitable investment in landed property. In trade and money-lending and, to a less extent, in financing village artisans, the trading classes found that large and certain gains were to be made; while modern industries required technical knowledge, and offered only doubtful and, in most cases, apparently smaller profits. The failure of the more intellectual classes to take advantage of the new prospects was especially marked in Bengal, where it contrasts with the success of local European enterprise. Here and in most parts of India, these classes grasped eagerly at the prospect of Government, professional, and clerical employment, and freely availed themselves of the system of education which was brought into being by the British Government, partly with a view to fit them for that very work. The effect of the purely literary type of education, which was the only one generally provided, has been so frequently discussed that it is not necessary to pursue the subject here in detail; it is, however, very necessary to realise its importance as a factor which has militated against industrial development, and to emphasise the necessity for a system of education which will impart a practical bias to the minds of Indian youths.

Exceptional position in Bombay.

102. The state of affairs in Bombay is altogether different. If the cause be sought, some indication of it may be found in the fact that Indians have held a large and important share in the trade of Bombay since the city first came into English hands. The Mahomedans of the west coast, especially, traded by sea with the Persian Gulf, Arabia and East Africa from much earlier times. The Parsees and Hindus from the northern Bombay coast districts are recorded, at the beginning of the British occupation, as taking, with the Mahomedan sects of Khojas, Memons and Bohras, a most important share in the trade of the port as contractors, merchants, financiers and shipbuilders, and have throughout shown themselves little, if at all, inferior to the Europeans in enterprise, and usually in command of more capital.

The valleys of the Nerbada and the Tapti had been for ages devoted to the cultivation of cotton. A considerable export trade was carried on from Broach and Surat, the ports at the mouths of these rivers, with the aid of an efficient maritime population. The Parsees also after settling in this tract secured a share of the trade. With the silting up of these rivers and the increase in the size of ships, Bombay became the centre of the export trade from the west coast of India. The import of coal from England facilitated the starting of the first cotton mill in Bombay in 1851 by a Parsee, Mr. C. N. Davar. The number of mills increased slowly at first, and it was not till the cotton boom of the early sixties had come and gone, and the value of steady industrial investments had made itself appreciated, that it became considerable. By 1876 it had risen to 29, and the manufacture of cotton had become accepted as a safe and profitable investment for capital, while by 1889 it had increased to 69, after which came a lull, but a further rapid rise took place after the year 1895, and the subsequent expansion has been continuous. Much of the capital invested was derived from the profits made in the opium trade with China, and, of course, from the money which the cotton boom brought into Bombay. The cloth trade with Africa and Arabia and the yarn trade with China had become important by 1882. The closing of the Indian mints in 1893 to the free coinage of silver, together with the industrial development in recent years of Japan, which now not only supplies its own needs but is a keen competitor with India in the China yarn market, have to some extent retarded the rapidity with which the Bombay yarn industry was previously expanding, and have turned the attention of those interested in it to the production of cloth on a larger scale. At the present time, the number of mills controlled by European interests is trifling, and the proportion of European mill employés also tends to decrease. The marked contrast between the trading and industrial position of Indians in Bombay and Calcutta, and the light thrown thereby on the important question how to assist the Indian people, generally, and educated Indians, in particular, to take an increased share in industrial enterprise, must be the excuse for a somewhat prolonged discussion of this subject.

It is noteworthy that in many cases the classes most successful in industrial and trading enterprise do not care for employment of a nature demanding skill in industrial technique. In some parts of India, Brahmins, though less engaged in trade, produce a fair number of engineers and other skilled industrialists. It is not in manual skill, if they care to acquire it, or in the capacity for understanding technical problems, that the castes which have in the past sought knowledge rather than commercial success, are deficient; it is rather in enterprise and in business sense, qualities which cannot be developed by a purely literary education and are more dependent on youthful environment. A few individuals, possessed of greater determination or aptitude than their fellows, have, however, achieved varying degrees of success.

The *swadeshi* movement.

103. A brief account of the *swadeshi* movement, a popular effort to promote indigenous industrial enterprise which was taken up by the educated classes in most parts of India, though especially in Bengal, will illustrate both the desire of more advanced Indians for the industrial progress of their countrymen, and the causes which have hitherto combined to prevent their realising this ideal to any great extent.

The necessity of securing for India the profits which accrue from the manufacture of her raw materials, to the export of which her commercial activity has hitherto been mainly confined, had for many years been urged on the Indian public by Europeans as well as by Indians. Among the latter, the late Mr. Justice Ranade was the leading exponent of the new views, which involved an appeal to Indian capitalists to invest their funds more largely in industry, and to the younger members of the literary castes to abandon their traditional aversion from manual labour and to fit themselves for industrial enterprise. The Indian Industrial Conference, started in 1905 expressly to further this cause, has met regularly every year since, and has devoted itself to the dissemination of industrial information and to a propaganda of its views among the educated classes. At a slightly later date, *swadeshi* principles began to receive the support of the more advanced Indian politicians, especially in Bengal owing to local causes. The success of Japan in her war with Russia appealed strongly to the imagination of educated Indians, who saw in Japanese progress and efficiency an example of what could be accomplished by an eastern nation. It was to the policy of the Japanese Government that the great industrial advance of Japan was ascribed by them, and numerous Indians began at this time to repair to that country for industrial training. These causes led to the increased use of Indian goods and to the starting of small factories by Indians, especially for the manufacture of piece-goods, soap, matches, pencils, and cutlery, and of stores where the products of these factories were to be sold. This was in itself a laudable idea, and it was financially supported by many persons who were entirely free from all extreme political views. But the boycott of foreign goods, which was the form given to the movement by some of its more advanced supporters, carried with it the elements of failure, by alienating in many quarters the sympathy and support which it might otherwise have claimed.

104. The original movement also suffered from serious errors. Too many of its disciples were apt to suppose that, because an article was manufactured abroad and imported into India, it could necessarily be made in India at a profit. Unfortunately also, the promoters of the newly established concerns lacked business ability and practical experience, and overlooked the fact that the imperfect theoretical knowledge of an industry, acquired from the study of books or even in technical institutions, is an insufficient equipment for undertaking manufacture on a commercial scale. Professional men and landowners put money into businesses that commanded no better technical direction and expert knowledge than those of youths half trained in this way. Even where more experienced men were forthcoming to carry on the actual work, the industry

or its location was too often selected by its promoters without a due consideration of the economic factors involved; and concerns were frequently started with inadequate capital. For reasons which are discussed in the next chapter, Government was unfortunately not equipped to meet the tide of enthusiasm half-way; to guide it to success by expert aid and business advice; and to place the country on the path of sound industrial development by the provision of systematic technical and commercial education. The *swadeshi* movement thus resulted in numerous failures, almost always due mainly to lack of business aptitude and commercial and industrial experience in classes which had had no opportunity of acquiring them. It says much for the strength and soundness of the feeling which underlay the effort, that it still remains to some extent effective, and that a few professional men and landowners are still found, in Bengal and elsewhere, who support *swadeshi* enterprises with such capital as they can afford.

CHAPTER VIII.

GOVERNMENT INDUSTRIAL POLICY IN RECENT YEARS.

History of recent Government policy of industrial development.

105. The commercial instincts of the East India Company had from its earliest days in this country led it to make various attempts to improve those Indian industries from which its export trade was largely drawn, as, for example, by organising and financing the manufacture of cotton and silk piece-goods and silk yarn, although this policy met with opposition from vested interests in England, which were at one time sufficiently powerful to insist that it should be suspended and that the Company should instead concentrate on the export from India of the raw material necessary for manufactures in England. The effects of this traditional policy continued for some time after the Company had ceased to be a trading body, and even after it had been replaced by the direct rule of the Crown, and doubtless moulded such subsequent efforts as were made in the same direction by Government. But as *laissez-faire* views gradually gained increasing acceptance both in England and in India, these spasmodic efforts became less frequent, and the first attempt at a general policy of industrial development took only two forms—a very imperfect provision of technical and industrial education, and the collection and dissemination of commercial and industrial information. One expression of the latter policy was the Calcutta Exhibition of 1884-85, which led to the institution of the Calcutta Commercial Museum, now part of the Indian Museum, and to the examination of Indian industrial resources by the Reporter on Economic Products. Sir George Birdwood's work on the "Industrial Arts of India," the "Indian Art Journal," the Indian and Colonial Exhibition held in London in 1886, and the institution about 1890 of a series of provincial monographs on Indian industries may be regarded as isolated and desultory efforts in the same direction. Various experts also were employed to investigate matters of industrial importance and awaken interest in them, while the Geological Survey began to deal with the economic uses of minerals, a branch of its work which was more definitely systematised from about the year 1904.

All that was done, however, was due rather to a few far-sighted individual officers than to any considered and general policy on the part of Government, though it is true that Government recognised the need for such a policy by the creation in 1905 of a separate imperial Department of Commerce and Industry. Even so, it is believed that this department by no means took the form originally contemplated by Lord Curzon, the Viceroy responsible for its inauguration. It is to the initial phases of this movement and to the severe set-back which it received in 1910 from a decision of the then Secretary of State, after detailed proposals for organisation and work had been actually elaborated in the United Provinces and Madras, that we now desire to draw attention.

United Provinces.

106. In 1907, a conference was held at Naini Tal by Sir John Hewett, Lieutenant-Governor of the United Provinces, who had been the first Member in charge of the new Department of Commerce and Industry. The proposals accepted at this conference included the appointment of a provincial Director of Industries, advised by a board of officials and business men, whose main functions were to be the acquisition and dissemina-

tion of industrial information, the introduction of new and the stimulation of existing industries. For these purposes the Director was to be provided with an expert staff, and to have the control of industrial and technical education and, in particular, of a technological institute to be established at Cawnpore, the professors attached to which were to assist by investigation and advice in the solution of industrial problems. With the help of the staff of the technological institute, the Director was to pioneer new industries and to experiment in improved methods and demonstrate their application to certain existing industries on a commercial scale. In their Resolution No. 1163-XVII-415, dated 27th August 1913, the United Provinces Government reviewed the extent to which subsequent experience had led them to modify their ideas, which had, however, only been carried into effect to a very limited degree. Their most important conclusions were that the headship of the technological institute should be separated from the Directorship of Industries, owing to the fact that a scientist was clearly needed for the former and a man of general industrial and economic knowledge with a business instinct for the latter; and the recognition of the truth that the science of directing organised industrial concerns can only be learned by experience, and not in technological institutes, however elaborate their equipment.

In pursuance of the recommendations of the Naini Tal conference, loans or grants were given to several concerns, especially to sugar factories. Some of these were spent, under the advice of the Government Sugar Engineer, in remodelling existing factories. The inevitable difficulties besetting these early attempts to assist industry, in the absence of a properly considered and accepted policy or of a systematised organisation to give effect to it, are well exemplified by the history of the loan given for starting a sugar factory in the Gorakhpur district, and of the experimental cotton-seed oil factory at Cawnpore. The loan of seven lakhs of rupees was granted to the sugar factory in the hope that it would induce capitalists to establish cane factories on modern lines. It does not appear to have had any marked effect in this direction, nor in the training of Indian apprentices as sugar makers, which was one of its conditions. Though the proposal was examined and reported on in the first instance by the Sugar Engineer to Government and the Director of Agriculture, the terms of the loan did not bind the company to accept advice from, or even to permit inspection by, any Government officer. The machinery and the process adopted were not in all respects suited to Indian conditions; the first season or two were unfavourable, and the enterprise naturally suffered at first.

The Government pioneer oil mill was started at Cawnpore under the management of a European agency firm, to investigate the possibility of the extraction of cotton-seed oil on a commercial scale. The venture was initiated without the assistance of any expert in cotton-seed oil manufacture, and was subsequently closed down in consequence of orders of the Secretary of State of which more will be said below. The mill had not worked long enough to yield definite data of commercial value, though the results were said to be promising. It was made over to private owners, who found it necessary to modify the plant installed by Government, which was not of the most suitable type for its purposes.

Madras.

107. In the early nineties of last century, proposals that the water power, which would become available on the completion of the Periyar irrigation project, should be utilised in the manufacture of aluminium by the then new electrolytic methods, had awakened interest in the Madras Presidency. Nothing has come of these proposals, and to this day the water power remains undeve-

loped; but in 1898, Government sanctioned experiments at the School of Arts in working up sheet and ingot metal procured from the British Aluminium Company to determine whether the metal would prove useful to the people of India, and, if so, to build up a market for it in the country, which would justify the establishment of hydro-electric works for its production from Indian ores. It was thought that, if aluminium could be smelted in India, it might prove a convenient substitute for copper, brass, tin, zinc and lead in many of their industrial and domestic applications. The average yearly imports of copper and brass from 1891 to 1896 had been over 24,000 tons with a value exceeding two crores of rupees, and it appeared well worth while to make some attempt to introduce a metal, which could ultimately be manufactured in the country, as a substitute for those which, as it then seemed, must be imported. In the course of six years, a fairly large business in aluminium hollow-ware was developed, and a demand was created which led to the establishment of a number of small factories in other parts of India. At the end of 1903, the Madras Government considered that they could not usefully carry on the work any longer, and they sold their plant and stock *en bloc* to the Indian Aluminium Company for a lump sum which left them with a clear profit of Rs. 30,000 on their experiment. The imports of the metal thereafter steadily increased, and in 1912-13 amounted to nearly 1,800 tons valued at over 25 lakhs of rupees, but the outbreak of war seriously restricted further progress, and the prohibition of imports of aluminium in 1916 necessitated the closure of the factory, at least temporarily. The experiment has not yet achieved its original object, but it has created a large market for aluminium in India which is a desirable preliminary to the establishment of works in the country for the extraction of the metal. During the five years 1911—1916 (in two of which operations were seriously affected by the war) 5,737 tons of aluminium, valued at over 89 lakhs of rupees, were imported.

The success which attended their initial industrial endeavour led the Government of Madras in 1899 to obtain sanction from the Secretary of State to the appointment of a whole-time officer, to supervise and stimulate technical and industrial education. In the first instance, the appointment was sanctioned for three years and was renewed for a similar period, and finally, in 1906, was extended for a further period of five years, when the officer was designated the Director of Industrial and Technical Enquiries. A detailed history of the work in Madras has been prepared under the orders of the Local Government and submitted to us as a "Memorandum on the Department of Industries in the Madras Presidency," (Appendix J.). From this memorandum it will be seen that step by step the Madras Government committed themselves to an increasingly active policy for the promotion of industries. Hand-loom weaving was greatly developed, the chrome process of manufacturing leather was introduced, irrigation by pumping was started and boring for water was undertaken; in addition, an organisation was created for assisting private individuals to install power-driven machinery and plant. These numerous activities aroused the opposition of the local European commercial community, who interpreted them as a serious menace to private enterprise and an unwarrantable intervention on the part of the State in matters beyond the sphere of Government; on the other hand, the Indian public approved of the policy which had been pursued.

Effect of Lord Morley's despatch of 1910 on industrial policy.

108. There were, however, certain incidents in the history of the development of industries in Madras which merit special notice. An industrial conference was held at Ootacamund in 1908. The Madras Government Order No. 2894, dated 17th October 1908, reviewing its recommendations, appointed

a special officer under the title of Director of Industries, to control pioneer enterprises and practical industrial education, and to establish a bureau of industrial information and an industrial museum. The conference had recommended that he should be assisted by an Advisory Board. Technical education was to remain under the Director of Public Instruction. But when the scheme was laid before the Secretary of State (Lord Morley), the essential feature of experiment and demonstration by Government agency on a commercial scale entirely failed to secure his approval. In his despatch No. 50-Revenue, dated 29th July 1910, Lord Morley said that the results of the attempts to create new industries were not of a character to remove his doubts as to the utility of State effort in this direction, unless it were strictly limited to industrial instruction and avoided the semblance of a commercial venture. The policy, which he was prepared to sanction, was that State funds might be expended upon familiarising the people with such improvements in the methods of production as modern science and the practice of European countries could suggest. Further than this the State should not go, and it must be left to private enterprise to demonstrate that these improvements could be adopted with commercial advantage.

Lord Crewe, who followed Lord Morley as Secretary of State for India, in his despatch No. 24-Revenue, dated March 12th, 1912, expressed views somewhat divergent from those of his predecessor :—

> "The creation of a separate Department of Industries in the Madras Presidency must turn on the question of the functions proposed to be assigned to it. As regards the latter, I must reaffirm my predecessor's decision against the extension of its activities to trading on commercial lines. I have no doubts as to the wisdom of that decision. At the same time I desire to point out that the Government of Madras appear to have placed too limited a construction upon the orders given in my predecessor's despatch of 29th July 1910. The policy which he then sanctioned was that State funds might be expended upon familiarising the people with such improvements in the methods of production as modern science and the practice of European countries could suggest. This need not be interpreted as confining instruction solely to industrial schools. I am prepared to recognise that in certain cases instruction in industrial schools may be insufficient and may require to be supplemented by practical training in workshops where the application of new processes may be demonstrated; and there is no objection to the purchase and maintenance of experimental plant for the purpose of demonstrating the advantages of improved machinery or new processes and for ascertaining the data of production. I have, for example, in view the experiment which the Government of the United Provinces is now carrying on with a small sugar plant. Such an experiment does not exceed the limits within which the Government of Madras may promote the industrial development of the Presidency."

Lord Crewe stated in addition that he was prepared to sanction the constitution of a Department of Industries on the lines subsequently laid down in the Madras Government Order No. 568, dated April 1st, 1914, where the functions of the Director of Industries are defined as follows :—

(1) to collect information as to existing industries, their needs and the possibility of improving them or of introducing new industries;

(2) to carry out and direct experiments connected with such enquiries;

(3) to keep in touch with local manufacturers, to bring the results of his experiments to their notice and to obtain their co-operation in the conduct of operations on a commercial scale;

(4) to supervise the training of students; and

(5) to advise Government with regard to technical matters involving legislation.

109. Even after Lord Crewe's despatch the Government of India seemed to be in doubt as to how far they would be justified in sanctioning proposals for demonstration plants, financial assistance and other forms of direct aid to industries. Their desire to move in these matters, which had not so far reached the stage of active fulfilment, had received a decided set-back. The difficulties were increased by the fact that they had neither the organisation nor the equipment to give effect even to the comparatively limited policy sanctioned by Lord Morley. It was not, however, till some time after the outbreak of war that they resolved to examine the question in a comprehensive way, and to that end appointed our Commission.

The attitude of Government did not satisfy the important section of Indian public opinion which desired the industrial regeneration of the country. The reversal of the policy enunciated by Lord Morley was frequently demanded; and the success of Japanese industries, brought home forcibly to India by a very large increase of Japanese imports, was cited as an instance of what a previously backward eastern nation could accomplish with Government encouragement.

Subsequent history of Government action.

Eastern Bengal and Assam.

110. The Eastern Bengal and Assam Government held a conference at Dacca in 1909, which made certain proposals involving the creation of a Department of Industries and the establishment, in connection with a scheme for technical and industrial education, of a central institute at Dacca, one function of which would be to impart, with the help of small Government factories grouped round it, practical training under commercial conditions. The introduction of pioneer factories was also proposed. The Secretary of State (now Lord Crewe) expressed general approval in his despatch No. 12-Public, dated 19th January 1912. A scheme had also been devised for a technological institute at Calcutta; but owing to the readjustment of the boundaries of the Bengal provinces in 1912, it was found necessary to recast both these schemes, and with this object a report was prepared in 1913. No practical effect has so far been given to these proposals, which have been criticised in paragraph 219 of the Bengal District Administration Committee's report as tending to give too purely educational a bias to the objects and methods of the Department of Industries.

United Provinces.

The United Provinces Government appointed a Director of Industries in 1910, and further loans were subsequently made to various industrial concerns by this Government. A depôt for the sale of the products of cottage industries was started at Cawnpore; a glass worker and a press-tool maker were obtained from England; and various investigations were made into the possibilities of certain local products, notably dyes and tanning extracts.

Other Provinces.

Directors of Industries have been appointed by the Governments of Madras, the Punjab, Bengal, Bombay and the Central Provinces. These appointments have been filled, at any rate temporarily, from the Indian Civil Service.

Madras.

In Madras, the Industrial Department was broken up, after the receipt of the Secretary of State's orders of 1910, into a Pumping and Boring

Department directly under Government, and an Inspectorship of industrial schools under the Department of Public Instruction. Both these branches were for a time under the control of the same officer, who was assisted by dyeing and leather experts in other work which he was also detailed to supervise. The Industrial Department was reconstituted with effect from 21st March 1914, but owing to various causes little progress has been made in the work under the charge of the dyeing and leather experts, though a central institute for dyeing, weaving and metal work in Madura is under construction, and a tanning and leather school has been in existence for some years. After the outbreak of war, the Madras Government thought that an effort should be made to take advantage of the temporary cessation of foreign competition to start new industries and revive certain ostensibly promising industrial ventures which had previously failed. The manufacture of glass, paper and pencils, and oil-seed milling were attempted, but unforeseen difficulties arose from inability to obtain plant and the services of suitable experts. The glass experiments completely failed, and the attempt to introduce modern methods of milling oil seeds, owing to non-delivery of the machinery, did not advance beyond the experimental stage, the results of which were favourable. The manufacture of paper was started again at Punalur, and, after unsatisfactory experiments with a number of Indian woods, the pencil factory set up in Madras has achieved considerable success with cedar wood imported from British East Africa.

Bombay.

In Bombay, an Advisory Committee was appointed in 1915 to report on such schemes as were submitted for its approval, and advise the Government as to the support which should be extended to these. At the beginning of 1918 this committee was dissolved at its own suggestion and replaced by a Director of Industries.

Central Provinces.

In the Central Provinces, the Director of Agriculture in 1911 was appointed Director of Industries also and charged with the main task of aiding certain selected cottage industries. The staff of his department included a textile expert and a European craftsman, who is head master of the School of Handicrafts at Nagpur, and whose duties include the giving of advice and help to local artisans in wood and metal. In 1917, a separate officer was temporarily appointed as Director of Industries.

In almost all provinces, the Departments of Co-operative Credit assist cottage industries to organise, finance, purchase and distribute on co-operative lines. Little, if any, progress, however, has yet been made in co-operative production.

Industrial surveys.

111. Industrial surveys were undertaken at various times between 1890 and 1914 in Bengal, the United Provinces, the Punjab and the Central Provinces. The Bengal Government in particular carried out no less than three, but nothing definite seems to have resulted from any of them except the report. None of these surveys was made by officers with technical knowledge of any industry, and they were all confined to a description of the various provinces from an economic point of view, including superficial accounts of organised industries and more detailed investigations of small and cottage industries, with descriptions of processes, rates of wages, cost of raw material, and prices of and demand for products. The reports usually include proposals on very general lines for the improvement of local industries, with schemes for the organisation of the necessary staff. They are useful only for administrative purposes as reviews of the existing industrial position, and as affording a basis for the organisation of a local Department of Industries. Expert examinations of

particular industries also have been made in Bombay, but the publication of the information so acquired has not had much, if any, practical influence on the public.

This account of the efforts made by Government for the improvement of Indian industries shows how little has been achieved, owing to the lack of a definite and accepted policy, and to the absence of an appropriate organisation of specialised experts. Such experience as has been gained in the few attempts which have been made by the Imperial and the Local Governments is chiefly of a negative character; much valuable time has been lost, during which substantial advances might have been registered, and the outbreak of war, which should have proved an opportunity to reap the fruits of progress, has served mainly to reveal and accentuate startling deficiencies.

CHAPTER IX.

THE ORGANISATION OF SCIENTIFIC AND TECHNICAL SERVICES AND THE PROVISION FOR RESEARCH WORK IN INDIA AND ABROAD.

Existing position of research work in India.

112. In the course of our tours we visited the Forest Research Institute at Dehra Dun, the Agricultural Research Institute at Pusa and the Indian Institute of Science at Bangalore. We also inspected the laboratories and equipment for research work in the Agricultural Colleges at Cawnpore, Nagpur, Coimbatore and Lyallpur. Further we made a special point of ascertaining what facilities existed under the Education Department in schools or colleges, under other departments of Government or privately, for research work, which would in any way promote the industrial development of the country. We also took occasion to enquire to what extent useful work has been done for India by the Imperial Institute, and to what extent it was considered desirable to refer problems to scientific men at home.

We were impressed by the value of the work which has already been done in the organised laboratories, and by the absolutely unanimous opinion which was expressed by all scientific officers as to the inadequacy of the staffs in point of numbers. Everywhere we were brought face to face with unsolved problems, requiring scientific investigation on an extended scale. On the one side, we saw the results accomplished by enthusiastic scientists, which, regarded from the purely economic aspect of the question, have added enormously to the productive capacity of India; on the other side, we were told by forest officers, agriculturists and indigo planters, engineers and manufacturers of the limitations placed upon the development of their work and the frequency with which they were brought to a standstill by a lack of knowledge regarding matters which could only be ascertained by systematic research work. Such success as has been attained by the Institutes at Pusa, Dehra Dun and Bangalore should not be gauged solely by its pecuniary returns, as the experts employed have had their attention directed to specific problems urgently calling for solution, and those which were likely to yield immediate results have naturally been taken up first.

We do not propose to deal with the general problems of pure scientific research; but in relation thereto, attention should be forcibly drawn to the striking success obtained by those officers in Government departments whose position has enabled them to specialise in their work.

Scientific advice an essential preliminary to development.

113. As industries conducted on modern lines, with facilities to keep abreast of developments in other countries, require technical as much as commercial experience and efficiency, it is desirable that each scheme should be examined by appropriate technical specialists before Government grants concessions or promises in advance any form of support to a new industrial enterprise. The absence of such technical officers and the consequent inability to distinguish between the good and the unsound industrial schemes offered, have given rise to undue hesitation in granting reasonable concessions. Frequently, therefore, there has been displayed by Government officials an apparent indifference to industries, which has been confirmed in the public mind by the absence of any openly expressed policy of encouragement.

The maintenance of a staff of suitable technologists and scientific experts is thus essential to industrial development. The most prominent deficiency and most promising field is in connection with research work on the raw materials of the country, especially on the vegetable products. As a consequence of the maintenance of a well organised, though small, Geological Survey Department for the past 60 years, our information regarding the mineral resources of the country has reached a relatively satisfactory stage; indeed, there are various mineral propositions that are merely awaiting advances in other directions for exploitation to commence, and Government has, at its command, in the Geological Survey officers, a corps of specialists who can be relied on for the necessary advice as development proceeds.

Research on vegetable products.

114. In the case of vegetable products, however, which occur in such enormous quantities and great variety, comparatively little work has been done of the kind necessary to translate the purely scientific data into a form suitable for the investing industrialist. Sir George Watt* has gathered together a mass of material which, in bulk, is evidence of the great amount of work done by him and by many other workers, official and private. But examination of the data concerning any product of probable commercial value generally brings into noticeable relief our ignorance of the very facts that are necessary for satisfactory industrial enterprise.

Samples of vegetable products have been examined by scientific workers, either in India or abroad; chemical analyses and other tests have been made; but often there is a doubt as to whether the samples were representative, whether they represented the plant at its best, whether similar or better results could be obtained under regular commercial practice, whether the material occurs in quantities that would permit of economic assembly at a suitable place of manufacture, or whether the accessory conditions are such as to justify capital outlay. Data such as these are necessary before a wise investor will risk his money in an industrial enterprise that depends on the maintenance of a supply of raw material of the right sort obtainable under favourable conditions.

Reasons why the carrying out of research devolves upon Government.

115. These data, it is true, can be obtained by any private individual or enterprising company, but it is important to remember that the individual or company, who undertakes "prospecting" work of any kind, expects very properly to be paid for each successful find much more than its actual cost: he must cover those of his losses that are due to unsuccessful ventures, and thus each enterprise that is taken up becomes charged with the expenses of those that are abandoned, the capital is correspondingly "diluted", and the industry is handicapped.

For most industries, it is not the chief raw material that gives the wise investor anxiety so much as the accessories. Thus the expert prospector of one substance may find his favourable results of no use, without favourable results of a wholly different class. Further, for general industrial progress the manufacturers of India must be in a position to make use of the results of work done elsewhere; but to apply them to local conditions is often by no means easy. In some instances, the information available is designedly left incomplete and gaps have to be filled in by trials and experiments, whilst the adaptation of methods and processes to Indian conditions and to Indian materials often involves research work of a complex and difficult character. Between the first stage of the inception of an industrial undertaking and its actual realisation there is usually a necessity for scientific and expert control. Much money in the past would have been saved, if the importance of these preliminary investigations had been realised. Ordinarily, no firm can afford to risk the cost of employing the various experts so required in an uncertain venture. This is more appropriately the business of the State, and the survey of its natural resources should be undertaken systematically, not in the form of an isolated series of special prospecting tests, which results in frequent repetitions, with wasteful overlapping of results and embarrassing gaps. The best intentions on the part of Government and a wise policy of industrial encouragement will never have their full value, unless preceded by a systematic survey of the country's natural resources. Private enterprise, however, will follow in a healthy form and with little artificial stimulus, when sufficient information of the right kind is made available in a way that reduces the opportunities of the speculator to prey on a credulous investor. The striking financial results, which followed quickly and directly after the employment from about 1905 of scientific specialists in agricultural research, demonstrate the wisdom of investing in modern science, and indicate also the opportunities that have almost certainly been missed in many other ways that affect the prosperity of the people and the revenues of the State. We have thus no hesitation in recommending a very substantial increase in the scientific and technical services as essential to industrial development.

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* "Commercial Products of India", published under the authority of the Secretary of State for India by John Murray, 1908, which is a short edition revised to 1908 of Watt's "Dictionary of the Economic Products of India."—Calcutta, 1885—1899.

Existing lack of organisation in the scientific services.

116. We have discussed with various witnesses the form of classification and organisation most likely to be effective for the scientific services of a country of the size and varied character of India. The problems of pure research require a high degree of specialisation, which will become more pronounced with the development of the sciences generally. For the practical application of the results of research, however, a wider appreciation of other sciences, an acquaintance with business methods, and sometimes intimate local knowledge are necessary. India has at times had the benefit of both types of scientific men, and for want of official co-ordination has often suffered from both.

In addition to a general deficiency of scientific and technical officers, there is a noticeable absence of anything approaching a natural classification of the various classes of experts employed. Scientific and technical officers are employed, sometimes as whole-time officers in an organised and graded service; at other times as experts on short-term agreements. There is a general want of uniformity and an absence of system about their functions, powers and terms of service. We have found the scientific experts forming heterogeneous groups, with no uniform conditions of service, with no definitely established policy or precise limits to their activities. The result is waste of money in duplicating equipment, absence of combined effort to form satisfactory reference libraries, overlapping of research work on some questions with consequent neglect of others, absence of authoritative check as to the value of results, confusion among the general public, and a disconcerting variety of isolated or short-lived serial publications.

117. If one takes any single science, say, zoology, the problems that arise may be referred, in a purely haphazard way, to any one of many zoologists—to an officer working under the Forest Department at Debra Dun, to any one of the various kinds of zoologists employed by the imperial or provincial Agricultural Departments, or at the Indian Museum at Calcutta. Not one of these officers

has any regular means of knowing what the others are doing; there is no one to check his results, and no one journal to which outsiders can refer as covering the whole range of zoological research activities in India. The zoological staff of the Calcutta Museum has recently been constituted as a Zoological Survey of India, but there are still more official zoologists outside than within the new department, which consists of only four zoologists.

The members of the Botanical Survey of India are only five in number, but all are largely occupied with extra-departmental duties, while a far larger number of official botanists are employed in quite other departments.

For the various chemical problems that are essential to industrial development in the country, this form of organised confusion exists even on a larger scale. Chemists are employed by the various provincial Agricultural Departments, but some of them we found to be occupied with problems like dyeing, paper-pulp making and the extraction of drugs, being apparently unconscious of what has been done, and is now being undertaken, in other parts of India. Chemists are employed at the cordite factory near Wellington under the Ordnance Branch of the Munitions Board. A tinctorial chemist is employed under the Director of Industries in Madras, and another under the Director of Industries in the United Provinces. A mineral chemist works under the Geological Survey. One or two metallurgical chemists are engaged as inspectors of steel at Kalimati. Chemists are employed in the Medical Stores Department, in the Mints, in the Forest Department, under the Superintendent of Local Purchases, under the Collectors of Customs, as professors in various Government Colleges, and as chemical analysts to Local Governments, while there appear to be no definite conditions governing the reference of chemical problems to the Imperial Institute in London. Most of these chemists may be required to give authoritative advice on any branch of chemistry; they are in isolated posts, generally with no official prospects of promotion of a kind that would satisfy any scientific man of energy and ability. It is not within any one's powers to obtain a collective opinion on any chemical question. The permanent official establishments are also supplemented at irregular times by the employment of temporary experts, on the apparent assumption that India has insufficient problems to occupy the life's work of one man in connection with such large industries as silk, tanning, glass, glycerine, paper-pulp, and soap.

Apart from the dissipation of energy due to this unorganised variety, the employment of isolated experts, whether permanent or temporary, results in a waste of money. A scientific service, with a definitely established position, can attract recruits for smaller initial pay than one of unknown prestige. Many of the scientific specialists quickly reach their maximum salaries, and, witnessing the gradual rise in pay and position of their contemporaries in other services, naturally grow discontented, and consequently become of reduced value to the country. In view of the fact that no quantitative standard can be established to gauge scientific research, no one can say what the country loses by discontent among its scientific staff.

Classification of scientific officers.

118. There are two principal ways in which scientific officers can be classified, *viz.*, (*a*) by taking the single science subject as the main bond of union, or (*b*) by taking the application of the various sciences as the line of primary grouping. The Geological Survey and the Agricultural Departments are our most satisfactory cases to illustrate each method of classification—the science of geology is the bond in the first case, and the application of such sciences as entomology, botany and chemistry to agriculture in the second.

(a) The science as the bond: the Geological Survey.

The Geological Survey is organised and equipped to deal with all problems connected with the development of our mineral resources, namely, the various branches of pure geology required to complete the general geological map of India, mineral statistics, information regarding mineral occurrences, and the conditions under which prospecting licenses and mining leases are granted. The department touches on public education by making its reference museum accessible to the public and by lending officers for short periods as college professors. Three advantages have followed from this compact structure:—

1. Everybody in India, whether an official or a private person, knows exactly whether a definite problem does, or does not, come within the province of the Geological Survey;
2. The activities of its officers can never overlap those of another department without being noticeable, while no other official, either of the Government of India or under a Local Government, can pose as an authority on mineral questions without obviously trespassing on the functions of a recognised and established department;
3. To the rest of the scientific world a member of the Geological Survey always retains his caste as a geologist, and the director of the department occupies *ex officio* an honoured position.

These circumstances add to the prestige of the department and tend to foster an *esprit de corps*, which lends an additional attraction to the service. The department has maintained without interruption, since its foundation, a set of serial publications which, being the only publications of their kind in India, enable it to enjoy the benefit of a monopoly in making exchanges with other institutions abroad. As a result, it possesses one of the most satisfactory reference libraries of its kind. This feature is one of very great importance, for it is difficult to over-estimate the value to the department of the certainty with which an officer can rely on his library in following up a line of research in any branch of pure or applied geology.

(b) Application of sciences as the bond: the Agricultural and Forest Departments.

The scientific officers of the Agricultural Department are bound together by the fact that their various sciences are applied to agriculture. At the Pusa Research Institute the scientific officers include mycologists, economic botanists, entomologists, bacteriologists and chemists. In each of the provinces, one finds, in addition to one or two recognised agriculturists, representatives of some one or more of these accessory varieties of scientific officers. We have been impressed with the high quality of officers who have been recruited in this way, and by the keenness which they show. They commence with a higher initial pay, and, up to ten years of their service, they have better prospects than the Geological Survey officers; but their official prospects are limited to the disappointingly short and blind alley into which they entered at an age too young to consider the ultimate aspect of this question. On the other hand, there is no check on the quality or quantity of work done by the various provincial officers. The chemist, the entomologist, or the botanist of each provincial Agricultural Department is a law unto himself, and is without the stimulating influence of other men of the same scientific caste. Although, for example, there is a principal for the Agricultural College at Coimbatore, the scientific officers associated with him, namely, an agricultural chemist, an economic botanist, a mycologist, and an entomologist, form, for research purposes, separate departments, each being free to communicate direct with the Director of Agriculture for the province.

Some of these specialists find it necessary to publish their results in extra-departmental journals. The plant pathologist at Pusa, for example, finds that his most suitable journal is one published at Berlin, and his scientific interests thus tend to become more closely linked with German vegetable pathologists than with his colleagues in the Agricultural Department of India.

A perusal of the list of agricultural publications in India shows the wide field of literature over which the agricultural research worker must range before he can be certain that he has discovered the latest and most up-to-date information on his subject.

The publications of the Agricultural Department fall into two main divisions:—

I. Those issued by the Imperial Department of Agriculture:—

1. The Agricultural Journal of India. (Quarterly.)
2. Memoirs. (Occasional) in series, such as Botanical, Entomological, Chemical, Bacteriological and Veterinary.
3. Bulletins.
4. Annual Reports, *viz.*,

(i) Scientific reports of the Pusa Agricultural Research Institute, (including the Report of the Imperial Cotton Specialist).
(ii) Report on the Progress of Agriculture in India.
(iii) Report of the Imperial Bacteriological Laboratory, Muktesar.

Besides these there are Proceedings of the Board of Agriculture (biennial) those of sectional meetings of the Board, and monographs and books.

II. Those issued by provincial Departments:—

(1) Annual Reports on the administration of the provincial Veterinary and Agricultural Departments.
(2) Annual Reports on the working of the Agricultural Stations.
(3) Occasional leaflets and bulletins on special subjects in English or vernacular for the use of cultivators and others.
(4) Magazines on popular lines in English and vernacular, either conducted by the department or under its patronage. These are monthly or quarterly, and are designed to keep the cultivators of the province in touch with the work of the department.

At the Forest Research Institute, Dehra Dun, we found a forest economist, a chemist, a botanist, a silviculturist, and a zoologist, each working on his own special lines under a senior Forest officer as Director of the Institute. It is the business of the Forest Economist to detect, if possible, ways for bringing the forest products into greater use for the various technical industries. To make his office of any practical value, therefore, he must acquaint himself with the details of industries like paper-making, match manufacture, the extraction of drugs, essential oils and perfumes, besides having a knowledge of the various uses to which special kinds of timber can be devoted. His activities cover a field nearly as wide as that formerly attempted by the Reporter on Economic Products to the Government of India; and, even if the range of subjects which he is supposed to know were possible to any human being, he would quickly realise that, by devotion to his special work, he must sacrifice his prospects of promotion to the higher posts in the Forest Department. There is also a single chemical adviser, whose research work has indicated the occurrence of valuable chemical materials obtainable from the forests, hardly one of which he can follow to the stage of establishing an industrial proposition that would justify commercial enterprise. His results, obviously, ought to come under review by a chemical service, which would include chemists who could make an independent estimate of their importance, and practical chemical engineers who could give authoritative information as to their commercial value, and thus facilitate the exploitation of the raw products, either departmentally or through chemical manufacturing companies.

Effect of systems of classification on Local Governments.

119. Before balancing the relative merits of these two systems of grouping scientific officers, it is necessary to take into consideration the way in which Local Governments may be affected by the adoption of either. There is no doubt that the second system of grouping officers, according to the practical application of their special subjects, lends itself more easily to the immediate requirements of Local Governments. The Geological Survey is strictly imperial in character and its officers are beyond the control of any Local Governments, but the range of its existing functions could not be undertaken by any Local Government, except by the institution in its province of another department of practically the same size; for the department is no more than large enough to include the necessary variety of specialists, together with an allowance for casualties, unsatisfactory recruits, and leave. On the score of expense alone provincial duplication in this way would be impracticable. Local Governments naturally desire to have control of the scientific officers working in their provinces; they believe that their interests are not always sympathetically considered by the heads of imperial departments; and the problems awaiting solution are so numerous that no imperial scientific department, as now understaffed, can satisfy the demands of Local Governments.

Arguments in favour of classification with the science as the bond.

120. Whilst admitting the danger of imperial scientific officers neglecting the immediate demands of Local Governments, we consider that the balance of advantage is distinctly in favour of grouping these officers by their principal subjects in imperial services, while providing arrangements for recognising the provincial claim to paramount authority in applying the results of scientific research. Our reasons are shortly these:—

(*a*) The functions of scientific officers are advisory, rather than executive. Consequently, quality of work is more important than promptness of action, and technical efficiency should be considered before purely local knowledge. One has to remember that, unless a scientific officer specialises, his advice may be harmful.

(*b*) It is not difficult to organise an imperial service so that some of its officers are placed temporarily under the orders of Local Governments or other departments for special investigations of local value or as consultants.

(*c*) Some Local Governments are too small to maintain anything like the required variety of scientific officers, or even of the equipment required for research work; they must always rely on an imperial staff.

(*d*) Local Governments cannot offer the prospects necessary to attract the best type of scientific man; they have no check on the quantity and quality of his work, such as is possible in a large service with a distinguished chief; they cannot create a reference library nor the atmosphere of science, without which most scientific men fail to work and flourish.

(*e*) The chief grievance of Local Governments is due to the fact that hitherto the Government of India has never had a staff sufficient to meet the urgent problems of the provinces. The cure for this is obvious and simple ; the scientific services hitherto have been, through failure to appreciate their full value, starved financially.

(*f*) When a provincial scientific officer is found to be unsuitable in any post, it should be possible to effect a change by his return to the imperial reservoir, where his idiosyncrasies can be accommodated. Under the present arrangements, an unsatisfactory specialist employed by a Local Government cannot generally be dispensed with, as the Local Government has no one of the same caste, who can fitly judge of an expert's qualifications.

The constitution of a certain number of scientific services based on the assumption that the science itself is a chief link between all members, does not prevent the formation of departments, either imperial or provincial, where the application of various sciences is the chief bond of union. To take a single scientific service as an example, many of the problems of tanning are mainly chemical, but the technical difficulties in connection with the industry are so varied, the field for research is so promising, and the duty of training young men to qualify technically is so pressing, that we do not hesitate to recommend a special department to develope an industry in which India is conspicuously well supplied with raw materials of all kinds. There is no reason why a department of leather technology, composed of different specialists, should not borrow one, two or more chemists from the Chemical Service, keeping them for long or short periods according to the nature of their work. Similarly, the Geological Survey, the Forest Department, the Agricultural Department and some of the provincial Departments of Industries might obtain the necessary chemical experts by the seconding of appropriately specialised chemists from the general Chemical Service.

Proposed organisation for an Indian Chemical Service.

121. The science subjects that have a direct bearing on industries and seem especially to merit official organisation along lines similar to those of the Geological Survey are chemistry, botany, and zoology. Taking chemistry first, it would be possible, for administrative purposes, to divide the chemists into three fairly compact groups which might be called, (*a*) agricultural, (*b*) organic, and (*c*) mineral chemists. In many ways the agricultural and the organic chemists would overlap, as many of the problems of agricultural chemistry are organic in their character. It is desirable, however, in a place like India, where agriculture is so extremely important, to give this branch of chemistry special consideration. The organic chemists would be occupied largely with problems connected with forest products, drugs, perfumes, essential oils and dyes, leather and sugar. Many of these officers would be eligible to officiate in the agricultural group. The mineral chemists would include metallurgists, the metallurgical inspectors, and the chemists of the Mints and of the Geological Survey. At some laboratory recognised as the headquarters of the service, there should also be at least one chemist who has specialised in physical chemistry, for a chemist of this type would deal with the physical problems connected with both the inorganic and organic substances. It seems to us that Dehra Dun possesses many advantages as a site for the headquarters of this as well as of some other scientific services. The whole of the chemists would be under the control, for scientific purposes, of a senior officer who might appropriately be called Chief Chemist to the Government of India. Under him directly would be the staff of the headquarters laboratory, including the physical chemists, and the specialists not assigned to provincial branches. The other three groups would be under the supervision of

three Deputy Chief Chemists. Junior members of any of the three groups would be lent to Local Governments and the principal Government departments for terms normally limited to five years. They would carry on the routine duties required, in some cases including teaching, and would undertake certain forms of research with the approval of the head of their service. All results of scientific and practical value would be published in a serial recognised as the authoritative publication of the Indian Chemical Service. Such a serial would quickly establish its position in the scientific world and would become a convenient medium for the publication also of papers by private chemists, resulting thus in the formation of an Indian 'school'. At convenient intervals, most or all of the chemists might assemble for a week's conference, which should be open also to manufacturing and private chemists.

Recruitment and terms of service.

122. For the recruitment of these scientific services, we recommend that to the utmost extent possible the junior appointments should be made from science graduates of the Indian Universities, and that the senior and experienced men who will be required to initiate and direct research work should be obtained on special terms from England, when such are not available here. We recognise that there will, at the outset, be some difficulty consequent upon the conditions that will prevail in England after the war, and because of the relatively small field of selection which at present exists in India. As development of science teaching at the Universities proceeds, and opportunities for technical training in India increase, we believe that the necessity for importing specialists will greatly diminish, and that ultimately the services will be mainly filled with officers trained in this country. Recruits for the scientific services, especially the Chemical Service, should be obtained at as early an age as possible, preferably not exceeding 25 years. We should thus secure the University graduate, who had done one or perhaps two years, post-graduate work, whether scientific or practical, but would not yet be confirmed in specialisation. The object of this proposal is to increase the sources of choice, and to make it less difficult for Government to dispense with the services of a recruit, if at the end of his probation he is found to be unsuitable. We assume that the requisite degree of specialisation will be secured by adopting a system, whereby study leave will be granted at some suitable time after three years service, when a scientific officer should have developed a distinct bent. (See also paragraph 334, Chapter XXII.) The creation of imperial services will enable us to pool our requirements in each science and thus reap the advantages of recruitment in a wide field. It will thus be possible, especially in the case of the larger services, to substitute a system of recruitment on a rough actuarial basis, to cover wastage and expansion, for the present *ad hoc* methods, under which vacancies have to be filled, as they occur, and with reference to special appointments, irrespective of the quality of candidates available at the time.

It is not practicable to give a precise estimate of the number of officers required and obtainable in the near future. It will be some years before it will be possible to obtain the full necessary staff in India. In addition there will be similar post-war demands made at home and in the dominions for scientific, especially chemical, experts, which will render it difficult to obtain suitable recruits from England. It is probable, consequently, that salaries higher than the pre-war rates will be demanded by suitably qualified experts, and for this reason, among others, we urge the speedy organisation of our scientific services on lines that will permit of training and turning to account young Indians who are now taking up science with no very definite object in view.

The chemists graded as 1st class officers and now employed as such by Government amount to just 50, with an aggregate salary bill of just under six lakhs per annum, chargeable partly to Local Governments and partly to the Government of India. There would be no difficulty in allotting profitable duties to about 120—130 such officers, with an aggregate annual salary of about 15 lakhs.

How effect should be given to recommendations.

123. It would be of little practical value to propose a full cadre under war conditions, but the chemical problems awaiting solution are so urgent that we recommend the early institution of measures for organising the research work of the various official and private chemists who are not already fully occupied with important routine duties. It will probably be necessary, at the right time, to appoint a special committee, which should include a distinguished chemist from abroad, to formulate proposals for the permanent organisation and the terms of employment of the new service, and for the location and equipment of research laboratories.

We have described with some detail the kind of organisation which, we think, will be necessary for a chemical service, because chemistry is so obviously and fundamentally essential to many industries.

Organisation of the other scientific departments.

124. Imperial departments for botany and zoology are already established, but, as already stated, they control only a small fraction of the existing official activities, although these, in the aggregate, are manifestly below the requirements of the country. Although agriculture and forestry show most strikingly the need for chemical, bacteriological, botanical and zoological (especially entomological) research and routine operations, these sciences appeared to us to have sufficient direct and indirect bearing on other industries to justify our inviting evidence from appropriate specialists. Among these, there was a general consensus of opinion in favour of the formation of imperial services, such as that proposed by us for chemistry and that which is already in existence for geology.

In the case of botany, the general opinion of qualified witnesses was also in favour of a single compact service, while, in the case of zoology, it may be advisable to recognise in a tropical country like India the large demands for, and high degree of specialisation required in, entomology. Our object of securing the advantages of scientific specialisation without introducing the administrative difficulties of subdivision seems to be met by recognising entomology as a distinct administrative unit.

Mr. T. Bainbrigge Fletcher, Imperial Entomologist at Pusa, has elaborated a scheme which we have published in full, (Appendix K), for we consider it typical of the claims which may be put forward for increased recognition by other groups of scientists. In many respects this scheme falls into line with what we regard as the most suitable form of organisation, in view of the fact that it is not practicable to provide sufficient special entomologists for each of the various groups of insects, as well as for the application of the subject in a country as large as India. We consider that he has established a fair claim for a more thorough recognition of entomology and has given good reasons for the maintenance of a minimum staff of 20 superior officers.

We hesitate to offer suggestions in greater detail regarding the organisation of the imperial scientific services for bacteriology, botany and zoology, as we consider that the best plan will be the appointment of special small committees for the purpose of formulating proposals. These committees might appropriately include, in each case, a distinguished specialist from abroad. In our opinion, research work and science teaching must be intimately associated, and there should be a close connection between the organised services that we are proposing and the educational institutions of University rank in which science is taught. We have already stated that ultimately the services should be mainly recruited from the Indian Universities, and we hope that the Universities will in many instances find it advantageous to obtain their professors by borrowing men from the scientific services, either for short periods or permanently. We have little doubt but that the careers which will be open to officers in these services will provide them with excellent opportunities of obtaining a wide range of practical experience, both in research work and in industrial methods, and that, for this reason, they will attract many of the best University graduates. Whilst the services would offer a permanent career to perhaps the majority of men admitted to them, we contemplate that many would regard service in them as preliminary to independent work outside, either in public institutions or on private account. At the present time, there are few openings for scientific men except those offered by Government; but as time goes on and the industries of the country expand, there will be a steadily increasing demand for scientific experts on the part of large manufacturers. The proposed scientific services would enable this demand to be met, and we can suggest no equally effective means of providing for this future need so long as Government continues to be the chief employer.

Relations of scientific officers with the Education Department.

125. Scientists in the Education Department are at present recruited as members of the Imperial Educational Service through the Secretary of State for special "professorships". This system, although it has advantages over the former practice, which had less regard to the needs of modern specialisation, involves certain obvious drawbacks. The professors are comparatively young when recruited, and naturally develope, under novel conditions of life and work, new professional interests which may or may not coincide with the interests of their environments. We suggest that certain of the obvious drawbacks of the present system would be eliminated by seconding from the scientific and technical services suitable officers to act as professors for, say, five years in the various high-grade colleges under Government or University control. The advantages which such a system offers are mainly these:—

(1) There would be no necessity to recruit young and inexperienced officers through the Secretary of State or appointment boards in London, and it would greatly increase the prospects of obtaining suitable Indians for such posts.

(2) The professors would have in view a clear idea of the connection between the scientific and industrial needs of the country.

(3) They would remain in touch with their own respective services in selecting subjects for research.

(4) They would be better able more directly to train students who show the qualities that are suitable, as recruits for the imperial services.

(5) This system would have the advantage of giving a change of occupation to those who may tend to become stale and narrow through uninterrupted continuance in teaching under the same surroundings; while, by transference from the ordinary official service to colleges, technical officers obtain an opportunity of renewing in a well-proportioned way their general knowledge of their special professional subjects, and the practice of teaching will bring them into contact with new and important interests, namely, the

training of young men for professional careers. As members of services that come into contact with industrial life, they will have far better opportunities than isolated professors of securing suitable employment for their students.

We are of opinion that a system such as that indicated above, if worked judiciously, will result in mutual advantage to the Education Department, to the Universities, and to the special scientific services; it affords an opportunity for recognising the necessity of specialisation without the narrowing and deadening results which follow over-specialisation; it permits of accommodating peculiarities of temperament, which may not be foreseen at, or may develope after, the time of recruitment; and it offers the small but important advantage of helping the colleges to form collections of illustrative samples from duplicates that can be spared by the imperial scientific services.

Position of scientific officers serving under Local Governments.

126. We consider that the head of a scientific service should relinquish all administrative authority over any of his scientific and technical officers who may be transferred for service under a Local Government or under some department of the Government of India.

We do not think it practicable to formulate rules applicable to all such services regarding questions like programmes of research work, inspection of results and forms of publication, but we suggest the following general principles as necessary to ensure the maintenance of professional standards, with due recognition of local administrative authority.

(1) Whenever it is possible to lay down for any scientific officer a programme of research work, the local authority should not sanction it without consulting the head of the appropriate scientific service. This will prevent unnecessary overlapping or waste of time in taking up problems that are known to the central authority, from wider experience, to be infructuous.

(2) The head of a scientific service should have the power to inspect the scientific work of any of his officers who have been transferred to the control of a local authority, but his report should be made to the latter, who alone would retain the power of interference.

(3) Reports on research investigations, of a kind ordinarily suitable for publication, should be reviewed by the head of the scientific service concerned and should not be published without his consent. Ordinarily, such reports should be given their first formal publication in the recognised journal of the scientific service. This rule will not prevent the issue by the local authority of administration or operation reports, or the local reprint for popular use, either in full or in abstract, of papers already formally published in the authorised journal of the scientific service; but it must be remembered that local and popular journals will not ordinarily be recognised by workers in other countries and, therefore, will not serve to secure precedence or to justify quotation in scientific literature. It is important, therefore, to maintain the position of the authorised central journal, and to ensure its being made as nearly as possible a complete and authoritative record of scientific results; such a central journal will soon establish itself as the official gazette for its own branch of science in India, and its recognition will remove any temptation or excuse for publishing in foreign journals.

Research Work in India.

127. The preparation of an extensive programme of research and the employment of a number of officers on the solution of problems involving large possibilities to private trade necessitate the consideration of the relations between these officers and the industrial interests which they are intended to serve. The following points will certainly arise :—

Relations between research officers and industrialists.

(1) The nature of the assistance to private enterprise and the extent to which it should be given.

(2) The publication of the results of work, whether forming part of the regular programme of a Government department or undertaken on behalf of private individuals.

(3) The right to private practice in consulting work on the part of officers employed by Government.

(4) The payment of fees for work done on private account in Government research laboratories.

(5) The best means of encouraging private firms or individuals to set up on their own account as consultants.

We have considered these suggestions carefully and discussed them with various authorities during the course of our tours, and agree that the following general rules seem best to suit conditions as they exist now in India.

(1) Specialised research institutions and laboratories, such as those belonging to the Forest and Agricultural Departments, will generally not be in a position to take up work on private account. In the case of the former, almost all the work is already done for Government, which is by far the largest forest proprietor in the country ; in the case of the latter, the individual agriculturist works on a small scale and on a non-competitive basis. On the other hand, the Indian Institute of Science and the various research institutes that have been suggested will normally be employed on a great variety of problems received from many sources, and there is no reason why applications for assistance from private persons should not be entertained. Besides furnishing solutions to problems requiring specific researches, these institutions will also prove extremely useful to the public as repositories of technical and industrial information, and suitable regulations should be framed to encourage *boná fide* applications for assistance and information.

(2) Of the advisability of the publication of the results of research in pure science, there can be no doubt; and generally there is no disadvantage resulting from the systematic publication of the results obtained in what may be termed 'non-competitive' development work. The matter is altogether different with industrial researches which may yield results of great pecuniary value to the possessor, so long as they are in the nature of a monopoly, but may often lead to competition injurious to him directly they become public property. We consider that the results of all research work carried on in Government institutions should be regarded as the property of Government. The decision as to the expediency of publication or otherwise should rest with the controlling authorities ; and it will be desirable in the interests of all concerned to reach a clear understanding, at as early a stage as possible, on this subject in each case. We desire to lay stress upon the fact that instances may often occur in which it may be found undesirable to publish broadcast the result of industrial research, without in any way precluding its confidential communication to persons who may be interested in it, or who may be in a position to make use of it advantageously.

The data for research must, in the absence of any definite agreement on the subject, be considered to be the property of the applicant, and the question of their publication should be governed by recognised professional etiquette.

We are conscious that the above prescriptions will deter some persons from coming forward with requests for assistance; but these will be as a rule the large-scale industrialists, who are in a position to engage private consultants. The smaller operator, who will benefit most by this form of help, is usually working on a less competitive basis.

(3) We consider that the scientific services, which we propose to create, should be sufficiently well remunerated and should offer sufficient prospects to their members to render it unnecessary to engage them on terms other than those which have been found suitable for such branches of the public service as the Public Works Department; that is to say, private work for extra remuneration should not be undertaken without permission, which should only be granted sparingly and for exceptional reasons.

(4) The principles upon which fees should be levied for work undertaken for private parties are easily stated. Normally, the cost of such work must be paid for on some suitable basis to be agreed upon beforehand. This fee may take the form of a lump sum or of a monthly contribution to cover a share of the salaries to the members of the staff during the time they are employed on the work, or, in some instances, may be a combination of both methods. When a private concern desires to engage a Government research officer as a regular consultant, the question of fees and publicity should be settled on the same basis as for individual consultations. When the research is undertaken at the request of private individuals and is likely to be of public utility, such work should be done free of charge. Intermediate cases may occur; but they are not likely to be numerous or difficult to decide. A useful concession which might be readily granted to pioneers of new industries or of existing industries undertaken under new conditions, would be the privilege of obtaining not only free technical advice, but also the right to have research work taken up on their behalf in Government laboratories, without charge.

(5) The levying of the full cost of work undertaken on private account is likely to prove the best form of encouragement to the establishment of private, and usually highly specialised, research laboratories. It is the almost complete absence of consulting experts in this country which renders it difficult for Indian enterprises on anything but a large scale to obtain sound and disinterested advice. It will be one of the functions of the Departments of Industries to undertake such work; but the desirability of encouraging private consultants should always be kept in view, and the policy of the department should be directed towards this end. The growth of a class of private specialists in various forms of technology should, therefore, be stimulated, and Government departments should make use of their services, whenever there is advantage in doing so. We would deprecate the importation of specialists on short-term agreements, whenever it is possible to engage the services of men already practising in the country; and we recommend as a general policy that Government should, as far as possible, offer encouragement to private consulting engineers and specialists, whenever this can be done without detriment to the public interests involved.

Location of research institutes.

128. The scientific services which we have proposed above will contribute to the organisation of research work throughout India and the correlation of results obtained within their respective sciences. The provision for scientific research clearly postulates that of laboratories, and the question therefore

arises how those laboratories should be grouped and located. Two main suggestions were put before us in evidence, one that on grounds of economy and to create the scientific atmosphere necessary for research on as wide a scale as possible, all branches of scientific research should be grouped in a single institute; the other, that research institutes should be specialised, so as to bring them as closely as possible into contact with local industrial problems. A small number of witnesses suggested that research work generally should be relegated to a central institute: the Indian Institute of Science at Bangalore is the outcome of the idea that all sciences are sufficiently related to be brought into one institute.

Constitution of the Indian Institute of Science.

129. But the history of this Institute shows that, where the income is limited, research activities must be confined to a single branch of science, if results of practical value are to be obtained. Originally projected by the late Mr. J. N. Tata with the object of encouraging post-graduate research in pure physical science, it has, in the course of a comparatively short career, developed a distinct tendency towards the study of problems which are likely to lead to results of immediate economic value, rather than towards the pursuit of investigations of purely scientific interest.

The administration of the Institute is somewhat complex owing to the fact that it represents so many interests. Its income is derived from the original endowment, which yields annually Rs. 1,25,000, supplemented by an annual grant of Rs. 50,000 from the Mysore State; while the Government of India contribute a grant-in-aid amounting to one-half of that realised from the other two sources. The affairs of the Institute are managed by a Council, partly nominated by the contributors to the income and partly elected by a nominated Court of Visitors scattered over India. The supreme controlling authority is the Governor-General in Council, who exercises his functions through the Education Department; but certain powers are also vested in the person of His Excellency the Viceroy, who is the patron of the Institute.

There are two main departments, one dealing with electric technology and the other with chemistry. The latter is subdivided into three sections, each under a separate professor. The department of electric technology has failed to attract research students and is, for the present, merely a school for the training of electrical engineers; but the chemical department is given up to research work which, though not entirely, is, as we have already stated, chiefly of a practical character. The students, though few in number, come from various parts of India, and there are at present no signs of undue localisation in this respect; but this could not be said of the economic work going on in its laboratories, most of which at the time of our inspection had been taken up at the instance of the Industrial Departments of Madras, Mysore and Hyderabad. The Council of the Institute, through their Director, represented to us that, in their opinion, there was ample scope for developments, and that these would be undertaken as soon as the income of the Institute permitted. It was further suggested that, with adequate support, the Institute might be made the centre of chemical research for all India. We agree that it might be strengthened considerably with advantage; but we are definitely of opinion that its value to the industries of India is reduced by its distance from the places in which they are carried on. It is, we conceive, impossible to contemplate chemical research for the whole of India in a single institute, especially one so far removed from the industries which would be likely to require it.

Case for specialised research institutes.

130. India contains, as we have pointed out in Chapter II, a number of industrial towns and areas of varying size and importance, which have in some cases developed in certain industrial directions. We think that, in such cases, some of those centres afford the most promising bases for the establishment of specialised institutes of research, where the staff can maintain close touch with industrialists and industrial work, and where their investigations will be vitalised by the constant presentation of fresh problems of practical interest. While we consider it inadvisable at this stage to attempt any more precise indication of the places that should be selected for the sites of research institutes, we cannot refrain from drawing attention, not only to the great opportunities for research in a wide range of allied metallurgical and chemical problems presented by the group of works which are springing up near Sakchi, but to the special need which they will experience for assistance of this kind. Industries like the manufacture of iron and steel, which compete over their whole range of production with exactly similar articles produced outside India, and depend for the success of complicated processes on the application to local conditions and materials of principles ascertained and followed under widely different circumstances elsewhere, are far more dependent on local research than the cotton and jute industries. These two industries may be described as operative rather than constructive; and the evolution of their technique tends rather to develope at present in the countries which manufacture the machinery with which they are carried on. Future progress will clearly be directed towards the introduction of the more refined processes which are already in operation in the United Kingdom, and the extent to which research is needed in India for the improvement of the textile operations themselves is small. There are, at the same time, certain auxiliary chemicals required for textile work, and some investigation of the local manufacture and use of these is needed. We are in favour of specialised institutes of research, but it is clear that the location of these institutes and the selection of their groups of subjects are questions not free from difficulty, which require to be settled by expert opinion. We consider that the committees which we have proposed for working out the organisation of the scientific services, should include these matters in their enquiries.

Research Abroad.

Dangers of relying on research abroad.

131. Most of the witnesses whose experience entitles them to an opinion recognised the advantages of relying on institutions in the country for the necessary research work on raw materials. In the absence of a sufficient number of the right kind of specialists and for want of equipment, materials have been, in the past, sent for examination at the Imperial Institute and elsewhere abroad. It is obvious that this practice is far from satisfactory and rarely affords the information regarding our raw materials, which is necessary for their commercial exploitation. Much of the work which has been done in this way has been useless, and some of it contains elements of serious danger on account of the fact that the samples examined have not been representative of the average material obtainable in commercial quantities.

132. The study of raw materials required for industries can be undertaken effectively only by suitable specialists working on the spot, where abundant representative material can be obtained and where only the accessory conditions that are essential for commercial success can also be studied. This is especially the case with vegetable products, which change in nature and, therefore, in commercial value at different stages of their growth, and sometimes even

during transport over long distances. Preliminary tests by specialists in Europe may often lead to the detection of materials of previously unsuspected value; but in such instances it is evident, from the nature of the case, that the collector could not have been in a position to know whether his samples were representative. Unless, therefore, such preliminary results are taken up on the spot by properly qualified workers and are confirmed, condemned or developed, their publication must generally become a public danger.

In order, therefore, to make profitable use of any outside institution for research, it is necessary :—

(1) that the samples to be examined should be selected by a qualified authority in India,

(2) that the results of assumed industrial value obtained should be submitted to an appropriate department in India for revision before publication, and

(3) that only specific problems, for which suitable specialists are not obtainable locally, should be referred to institutions or authorities abroad.

The practice of referring samples to the Imperial Institute for technical examination commenced with the Reporter on Economic Products, who (1) organised the collection of commercial samples, (2) maintained for reference purposes in the Calcutta Museum a collection of duplicates, and (3) published for general information the reports received from home. In the absence of anything better, this system served a very useful purpose, in spite of the many mistakes made. Most of the duties which were attempted by the Reporter on Economic Products are now undertaken by scientific officers, especially under the Agricultural, Forest and Geological Survey Departments, and the existence of these specialists in India, with their well-equipped laboratories, renders unnecessary the maintenance in London of a general laboratory for research on Indian raw materials. The office of the Reporter on Economic Products has very properly been abolished, and, as the scientific staff of the Imperial Institute is necessarily without Indian experience and is limited to work on samples doubtfully representative in character, it is obvious that there is no longer any justification for the expenditure of Indian revenues on the Scientific and Technical Department of the Imperial Institute.

Special cases in which problems may be referred abroad.

133. At the same time, there occur, as already indicated, certain questions that necessitate reference to specialists abroad, and problems which recur so rarely that India alone cannot economically maintain in continuous work the equipment required for their solution. To deal with these relatively rare and special cases, scientific officers in the Indian services should be empowered to communicate, through a recognised channel, with the Scientific and Technical Research Department recently established in England. The problems will thus be referred to recognised and authoritative specialists.

CHAPTER X.

INDUSTRIAL AND TECHNICAL EDUCATION.

Reasons why India did not share in industrial evolution of West.

134. The history of the evolution in the West of new industrial methods which culminated in the rapid and striking changes of the latter half of the eighteenth century shows that a large part was played therein by the educated as well as by the capitalist classes. The encouragement of scientific research and its practical application by the Royal Society, and at a later stage by the Society of Arts, was closely paralleled by the fresh industrial ventures constantly being set on foot by merchants and other persons with capital at command. When the results began to reach India in the shape of machine-made imports, the movement had passed beyond the stage where imitation might have been easy and where the gradual evolution which had taken place in England could be readily imitated in India. To create an industrial organisation in this country comparable to that of western nations, to build up an industrial community capable of working such an organisation, certain positive measures were required, including the provision of industrial and technical education which we propose to discuss in this chapter.

135. The system of education introduced by Government was, at the outset, mainly intended to provide for the administrative needs of the country and encouraged literary and philosophic studies to the neglect of those of a more practical character. In the result it created a disproportionate number of persons possessing a purely literary education, at a time when there was hardly any form of practical education in existence. Naturally the market value of the services of persons so educated began eventually to diminish. Throughout the nineteenth century, the policy of Government was controlled by the doctrine of *laissez-faire* in commercial and industrial matters, and its efforts to develope the material resources of the country were largely limited to the provision of improved methods of transport and the construction of irrigation works. Except in Bombay, the introduction of modern methods of manufacture was almost entirely confined to the European community. The opportunities for gaining experience were not easy for Indians to come by, and there was no attempt at technical training for industries until nearly the end of the century, and then only on an inadequate scale. The non-existence of a suitable education to qualify Indians for posts requiring industrial or technical knowledge was met by the importation of men from Europe, who supervised and trained illiterate Indian labour in the mills and factories that were started. From this class of labour it was impossible to obtain the higher type of artisan capable of supervisory work. The more advanced Indian thinkers began at last to appreciate the dangers and difficulties of the position. The system of technical education which had grown up on the continent of Europe had already attracted the attention of manufacturers in Great Britain, and it was natural that a demand should be made in India for Government to provide similar facilities. Even when the necessity for action began to be perceived clearly by Government, the magnitude of the problem was hardly

appreciated; it was by no means sufficiently recognised that technical education is by itself incapable of creating industries.

Recent attempts to improve technical education in India.

136. It would serve no useful purpose to record in detail the history of the various efforts made by the Government of India and by provincial Governments to provide industrial and technical education suited to the needs of the country. The report of the Indian Famine Commission published in 1880, (paragraph 103), pointed out in striking terms the necessity of a diversity of employment to a country hitherto so largely agricultural. In 1882, the Government of India appointed a Commission to review the existing state of education and to frame a policy for its guidance in the future. The necessity for technical education was realised; but the Commissioners were instructed that to extend their enquiry in that direction would add unduly to the task before them. The publication, in 1884, of the report of the Royal Commission, appointed in England in 1881, focussed the attention of Government on the necessity for stimulating attempts specifically intended to develope the material resources of India and to render assistance to its artisans in the unequal struggle against the products of the factories and mills of the West, which had become greatly intensified by the cheapening of transport, caused by the improvement of marine engineering, the opening of the Suez Canal and the extension of railways in India. In their resolution of the 18th June 1888, on the subject of technical education, the Government of India pointed out that the education hitherto provided had been too exclusively literary in its bent; that industrial training was required in view of the necessity of securing a greater variety of occupations; and that technical education could be provided with advantage at once for industries which had already reached a comparatively advanced stage of development, such as the textile and engineering industries, though the danger of establishing a system of training for those insufficiently advanced was noted. The necessity of giving a more practical bias to general education was emphasised, and Local Governments were incited to take action in these directions. The immediate results were small; but the necessity for science teaching in the colleges affiliated to the Universities was recognised, and the provision for the technical training of engineers was greatly improved. Chiefly through private effort in Bombay, by the amalgamation of various funds, the Victoria Jubilee Technical Institute was started in 1887 to provide courses of instruction suited to the requirements of the growing Bombay mill industry. Elsewhere and especially in Madras, the provincial efforts were rendered comparatively sterile, owing to the general acceptance of the fallacious idea that it was only necessary to provide facilities for the acquisition of technical knowledge to ensure the subsequent development of industries.

137. At the beginning of the present century, it was realised that measures taken in the Education Department during the previous 15 years had been totally inadequate to meet the needs of India and the growing recognition here of the necessity for a greater diversity of occupations, to absorb the energies of the ever increasing numbers of the educated classes. Lord Curzon accordingly summoned at Simla in 1901 an Educational Conference which reviewed the situation and recommended drastic reforms in the methods of higher education, with a view to render them more effective and practical. Measures were taken in the first place to improve the teaching of the physical sciences. In this line of education great improvements have been effected, and it is now possible, in many of the colleges affiliated to the Universities, to obtain efficient instruction in pure science and to be trained in scientific methods of enquiry and research.

Technical Scholarships Abroad.

Institution of State technical scholarships for study abroad.

138. The Simla Educational Conference also dealt with technical and industrial education; but its recommendations were of little practical value owing to the dominating idea that it was outside the province of Government to take any part in the industrial development of the country, beyond the provision of facilities for acquiring technical education and of information regarding commercial and industrial matters. It was also not recognised by the educational authorities at the Conference that, to produce a class of men of a thoroughly practical turn of mind, it is necessary that the young Indian should be taken in hand at a much earlier age, when the brain is more susceptible to external suggestions. The influence of environment on the Indian school boy of the better classes is probably more important than hereditary tendencies, and the sooner he is brought into contact with constructive activities and taught to use both hand and eye, the more readily will he respond to the measures which may be devised to counteract the sedentary tendencies of his home life. Almost immediately after the Conference, the Government of India appointed a Commission to report upon industrial education; but the report of the Commissioners was never published. A more important outcome of the Conference was the establishment by the Government of India of scholarships to enable Indians to proceed to Europe and America for special training. The scholarships were of the annual value of £150 and were granted in the first instance for a period of two years, which was normally extended for a further year. From a statement furnished to us, it appears that under this scheme more than 100 students have been sent for foreign training, of whom over 60 have returned to India. The average cost to the revenues of the Government of India of each student who has completed his period of training is about £550.

In March 1904, an association was established in Calcutta for the advancement of the scientific and industrial education of Indians, the main object of which was to enable properly qualified students to visit America, Japan and other foreign countries to study arts and industries. Under this scheme, over 300 students have been sent abroad with the assistance of the association, to the funds of which the Bengal Government contributed an annual grant of Rs. 5,000, reduced, since the outbreak of the war, to Rs. 2,500.

Defects in system.

139. The results anticipated from the grant of these scholarships, whether by the Government of India or by the Bengal Association, have only in part been realised. This is due to inherent defects in the scheme adopted, and possibly even more largely in the methods by which it was administered. It was assumed that it would not be difficult for young men from India to get admission into works and factories where they would be given full facilities to obtain practical experience of the methods and processes employed, and opportunities for acquiring an insight into the business organisation which keeps the industry going. It seems also to have been assumed that students from India of fair intelligence and good education would be able to take advantage of these facilities and assimilate all the information placed at their disposal, in a period very much shorter than that which is considered necessary for young men in their own country. In practice, it was found that, while educational institutions were freely opened to the scholars, access to workshops was denied them, except in the case of manufacturing iron works and small industries of no great practical importance. A few witnesses complained of this difficulty, and similar representations were made to the Morison Committee who, in the report on the system of State technical scholar-

ships which they submitted to the Secretary of State in 1913, stated that concerns which possess valuable trade secrets or fear to assist possible competitors, prefer, when they admit learners, to receive men who are likely to remain their employés rather than foreigners. This is an attitude which is common to manufacturers all over the world, not excepting India.

The most successful scholarship holders have been those who, with some previous practical experience of their trades, were able to profit by the courses of technical instruction; but the scholarships have been frequently awarded to young men who had no previous practical knowledge of the industry which they proposed to take up. In some cases, they have been allowed to go abroad to acquire a knowledge of an industry non-existent in this country. It is, therefore, not surprising that many promising students have failed to profit by the system, and have found themselves compelled to attempt other means of earning a livelihood. Further, notwithstanding the fact that these scholarships were granted from the public funds for specific purposes, no organisation was created to ensure that these purposes were achieved, nor was any organised attempt made to help the scholarship holders on their return to India.

Latest rules for State technical scholarships abroad.

140. In the light of the experience gained since these scholarships were first instituted, the Government of India have recently issued revised regulations which should go far to remedy the defects we have pointed out. Local Boards of Selection are to be established in each province; and in the selection of candidates, men of business, Directors of Industries and employers' associations are to be consulted. The object in view will be to obtain candidates whose 'experience and intelligence' justify the expectation that their selection will help in developing the industries of India. Before scholarships are awarded, it is to be definitely ascertained from the India Office that facilities for the acquisition of practical experience can be provided. Educational qualifications have been prescribed which are generally suitable; but these will require some modification to adapt them to the system of technical education which we propose. This does not in all cases predicate courses of study and instructions leading up to University degrees.

The advantages of previous training in India are acknowledged in the new Government rules; but the provisions for giving effect to this principle are not in all cases sufficient.

141. The new rules represent in several most important respects a great advance on the previous procedure; but, in our opinion, scholarships should not be granted in those subjects for which India will provide adequate educational facilities. We may point out, for example, that our proposals in this chapter for the teaching of mechanical engineering would render it totally unnecessary to send students abroad for general training in this subject. Instead, therefore, of allowing, as the new rules do, a scholar to proceed to Europe after one year's training in India, we would prefer that he should go through the more prolonged courses which we suggest at one of the large engineering shops, and that scholarships should only be granted to men who intend to take up some special branch of mechanical engineering which has not yet reached full development in this country. As an instance, we would allude to the absence from India of electrical manufacturing firms, which renders it impossible for Indian students to obtain any real acquaintance with this industry except in foreign countries, although the knowledge so acquired would be of real value in ordinary electrical practice in India. Similarly, the opportunities for training in the textile industries provided by the Victoria

Jubilee Technical Institute in Bombay and by the numerous mills in the country, should be fully utilised before public funds are devoted to sending inexperienced young men abroad. The liberal policy pursued by the Indian iron works in regard to training young Indians renders it also probable that there will be little necessity to send students abroad to acquire a practical knowledge of the metallurgy of iron and steel.

Further, as will be seen in the subsequent portion of this chapter, we contemplate the establishment of much greater facilities for technical education and technological training than have hitherto existed, and, when these have been created, they should, while providing much of the teaching at present only to be obtained abroad, produce also a much greater number of really qualified candidates for scholarships for foreign study. In our opinion, these should only be granted to men who have already committed themselves to industrial work. The new rules to some extent favour this idea, but they do not sufficiently emphasise the necessity of this limitation.

We agree with the principle that scholarships should not be awarded for industries not existing in the country, and doubt whether their grant even to persons who can 'secure the co-operation of promoters' of non-existent industries will have very useful results. We see no reason, however, why vegetable oil pressing should be excluded from the list of industries which may be studied abroad; India already possesses a number of medium-sized oil mills and will soon have one or more large ones, where specialisation will be required on lines that cannot readily be learned in India.

Primary Education of Industrial Classes.

Necessity of primary education for labouring classes.

142. A factor which has tended in the past to delay the progress of Indian industrial development has been the ignorance and conservatism of the uneducated workmen. The evidence tendered by employers was almost universally in favour of labour, both skilled and unskilled, that had at least received a primary education. This is given in countries with which India will have to compete and is a *sine quâ non* in this country also. Some witnesses stated that the spread of education among the artisan classes tended to bring manual labour into contempt, and that the sons of artisans, educated beyond the primary stage, showed a distinct tendency to forsake their fathers' callings in favour of clerical work, but we think this view must be due to the wrong system of education which has been made available. We found that, while the employers of labour generally recognised the advantages of primary education among their work-people, as tending to make them not only more intelligent but also more self-respecting, yet in comparatively few instances have they made serious attempts to impart such education. There are not wanting, however, instances of enlightened employers who have provided primary and even elementary technical education. In the case of the Buckingham and Carnatic Mills in Madras this has been done on liberal and efficient lines. The industrial bias imparted by the education given there has had the result of keeping the pupils in the mills as intelligent and efficient workers, instead of leading them to desire clerical appointments, and the scheme may, therefore, legitimately be regarded as a good investment.

But we are not prepared to declare that the education of their labour is a duty of employers as such, and while we very strongly endorse the views of employers of labour regarding the fundamental necessity for providing some form of primary education for the artisan and labouring population, we are opposed to any scheme that would compel individual employers to provide such education.

This is a duty which, we think, rightly devolves on local authorities and on Government, a point which we have more fully developed in Chapter XVI, and we need only support the proposal that, when private employers undertake this task, they should be assisted in every possible way, including the allocation of grants-in-aid by the Local Governments. Although we recognise the practical difficulties in the way of finding a sufficient number of suitable teachers, we recommend that Government should consider the desirability of introducing as soon as possible into primary schools a form of teaching which will include drawing and manual training as a means of developing in the pupils a practical industrial bias.

We shall now put forward our suggestions for industrial and technical education in this country and we shall deal first with the case of cottage industries.

Cottage Industries.

History of industrial schools.

143. The spread of Christianity, especially in the south of India among the *Panchamas*, gave rise to a new class, the members of which could not be absorbed into existing cottage industries owing to the caste system, though they required a means of livelihood commensurate with the higher social status claimed by them. The great famine of 1877-78 left a large number of Indian orphan children to the care of Christian missionaries, and a few years later the first of the modern type of industrial schools was established by the late Canon Margoschis at Nazareth, in the Tinnevelly district of the Madras Presidency, to provide instruction in such trades as carpentry, blacksmith's work, weaving and tailoring, so that the boys might subsequently pass out into the world equipped with the means of earning their livelihood. The experiment was a success from the promoters' point of view, as the boys who had been trained as carpenters and blacksmiths were able to find employment in railway workshops and other organised industrial undertakings, whilst the weavers and tailors earned their livelihood by supplying the needs of the Anglo-Indian communities. The Nazareth Industrial School offered a career for orphan children and for the children of Christian converts, and it was copied in other parts of India, not only by Missions, but also in institutions started by Government, local bodies or private individuals. In places where local artisans were lacking in skill, these schools met a distinct want; but in others, they served merely to satisfy vague local aspirations towards the promotion of industrial education.

The Mission schools had, of course, their special object in view, but other schools which have followed in their wake, have not always appreciated the purposes which ordinary industrial schools should attempt to fulfil. The training they offer is of little value when it merely consists, as it usually does, in teaching ordinary bazaar methods through the agency of *mistris* who are paid much smaller wages than a good workman can earn. Something very different is wanted, and this can only be supplied by a head master or superintendent, who possesses not only a thorough practical knowledge of modern methods of handicraft and specialised experience in certain branches, but also the capacity to apply general principles to particular cases. Such a man can teach students to produce much better work than that of the bazaar worker with less expenditure of time and energy. Striking examples of the results of such teaching were seen by us in the case of several of the better managed industrial schools. Men of the type required, it is true, are rarely to be found in the country and require relatively high pay. A solution of the difficulty seems possible on the lines adopted in the Central

Provinces, where the head master of the School of Handicrafts at Nagpur is being placed in general control of similar schools, the superior staffs of which are selected and in some cases trained by him. Teachers for these schools can often be recruited from ex-pupils.

Recommendations of the Commission.

144. Industrial schools generally have failed to observe the distinctions which exist between industries, on the one hand, such as weaving and certain branches of metal work which come into competition with organised industries, and, on the other hand, trades like those of the carpenter and blacksmith which are still, in the main, carried on as handicrafts, even in organised workshops. Though as a rule the products of hand-loom weaving are of a different class from those of the power loom, the hand-loom weaver directly competes with the power-loom weaver, and his success or failure depends in the first instance upon the right selection of the appliances which he uses, even more than upon the degree of skill which he acquires in working them. It is a comparatively simple matter to train an intelligent hand weaver to use improved appliances, whereby his output will be greatly increased. The problem is to find an outlet for his increased production, and efforts to improve the lot of the hand-loom weaver must end in failure, unless attention is concentrated to a much larger extent than has hitherto been usual on commercial questions, which involve the purchase of raw materials, the selection of suitable designs and patterns and the establishment of commercial agencies for the disposal of goods. Our more detailed proposals regarding this type of organisation will be found in Chapter XVII.

On the other hand, in schools of handicrafts, the first essential is that the pupil should by degrees acquire a thorough knowledge of the craft and manual dexterity in carrying out its processes. The tools used are neither automatic nor semi-automatic in their action and the quality of the work turned out depends entirely upon the personal skill of the workman. The training is best given by a graduated series of exercises, and the best results can be obtained by an almost total neglect of commercial considerations, so far as they affect the disposal of the product. At this stage the quality of the work is of more importance than the quantity, and it is only when skill has been acquired that attention should be concentrated on productive capacity. The craftsman who makes his living as a cottage worker requires a different and somewhat more elastic training than the craftsman who becomes a unit in an organised industry. In the latter case more specialisation is usually needed, and the man will have to work under conditions very different from those which can be obtained in a school of handicrafts, where it is difficult to maintain the discipline of a workshop or to attach great importance to what may be termed commercial considerations.

The industrial school is, at best, a defective instrument of education owing to the non-commercial conditions under which it must necessarily be carried on. In spite of this, it seems to be the only means by which the indigenous artisan can be trained; though, in the past, through his ignorance and lack of education, and through the imperfections of their equipment and teaching staff, industrial schools have failed in the majority of cases to achieve any appreciable results. While, therefore, they are institutions to be encouraged and developed within the limits just specified, we regard them as altogether unsatisfactory, if employed to train artisans for organised industries.

Control of industrial schools.

145. In the Madras Presidency, the industrial schools are under the control and inspection of the Director of Industries. In the United Provinces, the schools are still attached to the Education Department, but are inspected by the

Director of Industries who practically controls them. In the Central Provinces, the only school visited by us was under the Department of Agriculture and Industries. In Bengal, Bombay and elsewhere, the Education Department still controls industrial education. In some cases, special inspectors have been appointed. The absence of any direct means of keeping the schools in touch with the cottage industries of the districts in which they are situated is very noticeable. The remedy obviously lies in the transfer of the control of industrial schools from the Department of Education to that of Industries. Our general views on the important question of the control of industrial and technical education will be found at the end of this chapter (paragraphs 177-179).

Organised Industries.

General principles affecting the training of men for organised industries.

146. We shall now put forward our recommendations for the training of men for organised industries. We shall discuss more particularly the training of the supervisor class, in view of the fact that under present conditions there is a far greater lack of Indians qualified for such positions than of Indian artisans and operatives. Though it is true that the supply of these latter is generally insufficient and that their skill and intelligence require improvement, the main remedy needed is the provision of an incentive to excel, which can be given only through a general improvement in their conditions of life. We shall, however, in setting forth our scheme for engineering training, suggest a system of training engineering artisans, which can be applied, as opportunity offers, to the case of other large-scale industries.

Before framing our proposals, we find it necessary to point out in what ways the various industries differ, from the point of view of the training which will be required by the persons who will engage in them as supervisors. We may explain, in the first place, that the method of recruitment in force in England, where industries have gradually grown up by natural evolution, is not yet possible everywhere in India. The supervising staff in a large number of English industries is recruited entirely from one or other of two sources—from artisans who have worked their way up, obtaining the necessary theoretical knowledge by private study or in evening classes; or from young men who have some connection with the industry and have taken a course of special teaching, followed by or combined with practical training in the factory. It is very exceptional for a person unconnected with the industry to attempt to enter it. We believe that circumstances are not the same in certain other countries with equally advanced industrial organisations; that these possess a more complete equipment for practical and theoretical training outside the factory, and that persons with no previous association with the industry are frequently admitted into it after passing through training institutions. In the case of engineering, on the other hand, it is common in England for pupils and apprentices to enter the shops without previous connection with the industry. When we come to discuss the various forms of technical training required in this country, we are faced with the fact that there are very few industries which can completely, or even nearly completely, supply from the ranks of the workmen or of the educated classes connected with the industry the recruits wanted for the control of existing or future undertakings. The former are at present too uneducated to rise; the latter are to a large extent non-Indians, and are in any case few in numbers. We shall therefore require special arrangements to supply candidates for supervising posts with the practical training in the factory which, in the case of so many industries in England, is obtained almost automatically.

We must remember, in the first place, that successful supervision implies a knowledge of business, including such questions as the control of labour, and these can only be learned by actual experience. In the next place, they require that a man should, especially in the earlier stages of commercial employment, submit to long hours and hard conditions. In some cases, he can accustom himself to these during the period of training, and, wherever possible, he should be compelled to do so.

Classification of industries for purposes of training.

147. From the point of view of the actual training, we may divide industries into two classes:—(1) those in which long practical experience is necessary for the supervisor to estimate the working conditions and judge whether the quality and output of the work is satisfactory; and (2) those where, on account of the automatic or semi-automatic character of the plant, or of the simplicity of the processes, the necessary knowledge can be more quickly acquired. As instances of the first class, we would refer to such branches of mechanical engineering as repair work or the making of machinery; the manufacture of pottery and glassware; textile work; tanning; and mining. We shall call these manipulative industries. The manufacture of sugar and chemicals, and oil and rice milling are examples of the second, which we shall entitle non-manipulative or operative. The first class of industries usually require a training in industrial concerns; but, in some cases, *e.g.*, textile work, they are carried on under conditions which make it difficult for the learner to acquire the necessary knowledge in the works themselves, and they can be learned more easily in instructional factories attached to schools. In this latter case, it must be remembered that practical training given in a school does not offer the student the opportunity of accustoming himself to mill conditions and of acquiring experience of mill management; though the greater facilities for learning more than compensate for this, these deficiencies must be made up for later. In the case of the second class of industries, the only training that can be given is mainly technological, consisting, for instance, of a course in industrial chemistry of a special type, together with some training in the handling of machinery and in the making of drawings. The student will require practical experience, but, from the nature of these industries, this need not be acquired at a very early stage in his career. A sugar-works manager or chemical manufacturer usually starts with a training in technological chemistry, and a less complete training, which he can acquire in a teaching institution, in mechanical engineering. He then goes as a chemist to a sugar factory or chemical works, and gradually familiarises himself with the general work of the factory, till he is qualified for more responsible posts. He neither requires, nor as a rule obtains, any special manipulative skill. A master-tanner's training is also very largely in a special branch of applied chemistry; but he requires some degree of practical experience of the industry, especially in the currier's shop. But we must again emphasise the fact, that actual works experience must be obtained at some stage or other in the student's career, and this can only be given in a factory working under commercial conditions. A man who is acquiring a knowledge of factory management in a chemical works, a sugar mill, or a brewery may also be earning his living as a works chemist; but that does not affect the principle. We desire further to point out that in manipulative industries carried out on a comparatively small scale, as is mostly the case in India at present with tanneries, potteries, and glass works, it is impossible to provide what we consider the ideal form of education, *i.e.*, the properly controlled training of apprentices in the works, with theoretical classes attached. The small-scale glass works, which exist in India at present, produce

only a limited range of inferior articles; a large modern glass works could not only provide for the systematic training of apprentices for all kinds of glass making and furnish the most effective basis possible for the future recruitment of the industry, but would also be in a far better position to resist foreign competition. The engineering industry is, fortunately, on a different footing. But for most other manipulative industries, the only way in which practical training can at present be provided is by means of a small factory run on non-commercial lines—a method which is exceedingly costly. It may be necessary in certain special cases to have recourse to it, but it is vastly inferior to the systematised training which can be given to groups of apprentices in large works with provision for theoretical courses alongside.

Different classes of training required.

148. We have, therefore, to provide for the following classes of higher industrial training:—

(1) Training for manipulative industries in works large enough to employ a number of apprentices, for whom theoretical teaching can be provided in class-rooms attached to the works.

(2) Training, in certain special cases, for manipulative industries in technical schools, with workshops or instructional factories attached. This method would be adopted in cases where there were no works available on a large enough scale, or where, as in the case of the textile industries, the necessary technical knowledge can be much more easily imparted outside the mill. The extent of the equipment required for practical work would depend on the degree to which manipulative knowledge is required in the industry. This training must be followed by a period spent in a commercial factory, probably on a very low salary or as a pupil.

(3) Technological training for non-manipulative industries, which would be given in a teaching institution, where a student would take courses in some special branch of technological chemistry, coupled with training in such subjects as mechanical or electrical engineering, which the particular branch of technology selected by the student may indicate as necessary. Such a course of training will often of itself create a wage-earner; but further experience is needed if the student wishes to rise in his profession.

The distinctions laid down above must not be considered as entirely rigid. There will be cases on the border line, which may be dealt with in one class or another, as local or personal convenience may determine. It will be possible also in the case of class (2) to group together in one teaching institution the training or some part of the training required for industries practised on a small scale.

In framing our proposals for a system of industrial training, therefore, we shall deal first with training in mechanical engineering, which is the most important need at present for India's development, and for which, fortunately, the facilities are considerable. We shall treat this question in all its aspects, including therein our proposals for the training of artisans and foremen, as well as of engineers. We make no specific proposals in this chapter for establishing the instructional factories to which we have alluded, although remarks will be found on this subject in Chapter XIV. But the advisability of providing this form of training in the case of any particular industry or province will depend on local circumstances, and it will be for Departments of

Industries to decide each case on its merits. We shall put forward our suggestions for training in technological chemistry, which we propose should be given in certain existing collegiate institutions. These, as at present constituted, are mainly concerned with training engineers and include facilities for a grounding in mechanical engineering, which will be sufficient for men of the class we have in view. We shall next explain our conclusions regarding the Victoria Jubilee Technical Institute, Bombay, which provides both technological and technical training; and then, after putting forward our views on mining and metallurgical teaching, we shall discuss the measures required for the control and co-ordination of the various forms of industrial, technical, and technological training, and for bringing our training institutions into touch with employers of labour.

Training of artisans.

149. We may now discuss the question of the instruction of artisans for mechanical engineering. Looking forward as we do to a very great industrial expansion in the immediate future, we think that the present arrangements for the training of artisans are totally inadequate, and that it is essential that steps should be taken as early as possible to provide a much better training for many more boys. We were much impressed by the great possibilities for training in mechanical engineering in the numerous large railway workshops, which are so distributed as to form convenient centres in almost every major province of India. Private engineering establishments on a large scale, though confined to a few important cities, are also suitable for the same purpose. But the system for the apprenticeship of artisans pursued in these shops is at present rudimentary. The sons of employés are taken on at the request of their fathers and turned into the shops to pick up a knowledge of the trade as best they can. They are paid small wages to begin with, and the amount is gradually increased as they grow older and more useful. There is no regular apprenticeship, and not infrequently the boys are tempted to leave long before they ought, by the offer of slightly higher wages outside. We point out elsewhere the risk of boys, who have received a little education, leaving their hereditary manual occupations for small clerical posts. The only remedy is to improve the social status and prospects of the skilled artisan. Though such a proposal has been supported by numerous witnesses, we are opposed to any legislation designed to penalise the employment of indentured apprentices by third parties; and would leave the system of indenture on the same contractual basis as at present. We think, however, that much can be done to counteract the tendency among promising youths of the working classes to seek clerical occupation, by a more liberal treatment in respect of wages, the provision of opportunities for further education, and the institution of a better form of agreement. From the time a boy enters a workshop to learn a trade, he should be paid wages at least equivalent to what he would otherwise earn in the bazaar; from which, in order to secure his regular attendance and to provide inducements to him to go through a complete course of training, there should be placed to his credit every month a certain amount of deferred pay; and this, under the initial agreement, should only be due to him on the completion of a specified period of service, which should usually be about five years. Night schools have proved less successful in India than elsewhere, and even in England they are tending to fall out of favour. It should be recognised that, when a boy has done a fair eight hours' work in the shops, he is not fit to profit by class instruction. Every apprentice, therefore, should be given within the shop hours elementary technical education suited to the trade that he is learning, and he should be taught drawing and mensuration, so that he may at least be able to understand a plan and work from it. In large engineering establish-

ments where the number of apprentices justifies the expense, there should be a special officer to supervise them and see that in each shop they are properly employed. Supervision of this sort is still more necessary in the case of apprentices and pupils under training for posts of foremen and engineer officers, regarding whom we have made proposals in the following paragraphs. In some instances, the more intelligent and ambitious apprentices will certainly desire to acquire a working knowledge of English, which will enable them to communicate more freely with their superior officers and will give them access to sources of information denied to workmen unable to read and write that language. It is only for teaching of this kind, when there is a demand for it and it cannot be provided by other means, that evening classes should be accepted as a method of imparting instruction to apprentices.

The system which we have proposed above provides for the attachment of teaching classes to a single large shop. There may, however, be cases where works, none of which is large enough in itself to form the basis of an educational unit, exist sufficiently close together to form a group; and here, we think, teaching classes may be provided in a common school conveniently situated for apprentices attending the different works, and controlled by a committee on which the Department of Industries and the various employers may be represented. We think that this system might, when necessary, be extended to meet the case of apprentice foremen and engineers.

Raising the status of artisans.

150. We received many complaints regarding the unsteadiness and inefficiency of Indian labour, defects which, so far as they arise from a low standard of comfort, we have dealt with more fully in Chapter XVI. It is doubtful if sufficient inducements in the way of pay are yet held out to men to become really first-class artisans. To reduce the difference between the pay of the skilled workman and the foreman, and so lessen the cost of supervision, it is necessary greatly to improve not only the skill, but also the prospects of the workman, and teach him to regard himself as a member of a skilled and respected body. Any means of raising the self-respect and social status of the artisan will benefit, in the long run, the employer no less than the employed.

The training of foremen: existing arrangements.

151. Above the skilled workman is the *maistry*, or foreman, and the provision for training such men is hopelessly insufficient. We were forcibly struck, when visiting the large railway and private workshops throughout India, with the almost complete absence of Indians from the ranks of foremen and chargemen—the non-commissioned officers of the great army of engineering artisans. At present these posts are filled almost entirely by men imported from abroad. The railway companies are endeavouring to supply this deficiency by training European and Anglo-Indian youths, the sons of their own employés as a rule, and with fair prospects of success. The effect on industries generally of the absence of men of this type is clear from opinions which have been expressed to us regarding the comparatively low state of efficiency of the plant in many factories which do not employ a high proportion of imported men on their subordinate staff. The continuance of conditions which force the industrialists of the country to import so many of their subordinate supervising staff is clearly most undesirable. They form a serious handicap to progress and militate against the ideal of an industrially self-sufficing India. Many men brought from foreign countries are found unsuitable on their arrival here; others take a dislike to the country or develope indifferent health, and are generally a source of anxiety to those responsible for bringing them out. It is common knowledge that no small

proportion of the men so imported have to be repatriated at great expense to their employers. Mechanics, as a class, are unwilling to leave their home countries to accept service in India, and the prospect is rather remote of suitable men being available for the new industries which we hope to see started. To meet this most pressing need, every effort should be made to create a class of Indian foremen and chargemen. A difficulty arises in this country from the fact that the educational attainments of the artisans are too low to fit them for such posts, while the stipends and the prospects offered are not of a nature to induce the better educated classes to spend a number of years as workmen, though this is the only way for them to acquire the practical experience which is essential, if they are to be in immediate charge of specialised sections of a workshop or factory. The attempts at compromise, which are now under trial in several technical institutes and schools, are not likely to meet with success, even when, as in some cases, the course of instruction is followed up by a few months in a factory or engineering works. Instructional courses do not familiarise the students with practical shop conditions, with their long hours and strenuous life and the demands which they make on the resourcefulness and intelligence of the supervising staff, nor do they enable them to discover whether such a life is one which they are physically able to stand or care to accept as a permanent occupation. Further, the students look on their few months' training under shop conditions as a test to be passed and put behind them, rather than as an earnest of the employment awaiting them after training, and the arrangements for the training of students in the shops do not, it would seem, really bring them into close contact with the principles underlying commercial engineering work. These defects have been recognised to some extent, and attempts to remedy them are now being worked out in the engineering schools at Lucknow, Bankipore and Nagpur. In these schools, the idea is to give an all-round training in the various engineering trades, simultaneously with instruction in drawing and in the elementary principles of science which find application in mechanical engineering. After a course of this kind extending over a period of three years, the pupils are drafted into the mechanical workshops, where it is intended that they should specialise in some particular department, in the hope that, if they apply themselves diligently to the acquisition of practical experience, they will in a few years become capable of being entrusted with supervisory work. These attempts to combine teaching with workshop practice are not, however, in accord with the idea supported by the balance of opinion among mechanical engineers all over the world, that the technical school courses should not precede workshop training. It is important to remember that theoretical training is doubly valuable when given to a student who has in his mind a definite picture of the conditions under which it will be applied. The result of our enquiries convinces us that the same system is equally suitable under Indian conditions, and we describe in the next paragraph the lines on which it should be worked.

The training of foremen: proposals of the Commission.

152. Railway workshops are, as we have stated, in many cases already receiving European and Anglo-Indian apprentices, to whom some degree of technical training is given with the object of enabling them to obtain posts as foremen, or, in special cases, even higher appointments. There is, however, a noteworthy absence of provision for the middle-class Indian. We consider it of great importance that the conditions of training should be such as the educated Indian youth will consider consistent with his sense of self-respect; for if this is not satisfied, we shall be depriving ourselves of a most promising field of recruitment. The arrangements made for Indian apprentices are at present inadequate; and the stipends paid them during the period of training and the

salaries offered on its completion are very much lower than the corresponding amounts in the case of Europeans and Anglo-Indians, a fact which is largely responsible for the failure of the better educated Indians to take advantage of these courses. As regards salaries, we consider that the principle must be adhered to that equal proficiency should be equally remunerated. The inequality of stipends is to some extent justified by the difference in the standard of living between Europeans and Anglo-Indians on the one hand and some classes of Indians on the other, though the stipends at present offered to Indians assume too low a cost of living to meet the case of the educated middle classes. We think the difficulty might be got over by allowing free board and lodging to all Europeans and Anglo-Indians, and to such Indians as prefer it. To other Indians, a stipend to cover board expenses based on the standard of living of the middle classes should be given. Apprentices of all kinds should receive a monthly sum over and above the expenses of their board and lodging, depending on the length of time they have worked and on their efficiency in the shops. We consider that every effort should be made to develope the training facilities existing in these shops, grants being given from Government funds for the establishment of technical classes, together with hostel accommodation and such other amenities as are necessary to attract educated Indian youths of the middle class. The precise allotment between Government and the Railways of the extra expenditure entailed will require further consideration. With the technical school alongside the workshop, it becomes possible to provide an almost ideal course of training. Almost equal possibilities for training can be made available in a few of the larger private workshops, and we do not doubt that the managements of these would welcome the provision of similar arrangements for the technical training of their employés. In discussing the question of training industrial artisans, we have suggested the adoption of an apprenticeship system, and we think that a precisely similar system should apply to the more advanced class of students with which we are now dealing. The regulations for the admission of apprentices and for the working of the system generally should secure the admission of a proper proportion of Indians and the fair and equal treatment of all classes in their course of training, while upholding the authority of the workshops management to the fullest extent. The indentures should be for a period of four or five years, and, as we have said already, the apprentices should be paid wages. Apprentices of this class should start work usually between 16 and 18 years of age. If they enter the workshops at too early an age, their physique will be insufficiently developed to stand the stress and their previous opportunities for obtaining the necessary education will be unduly restricted.

An example of a scheme of this type, worked out by officers of the East Indian Railway Company, will be found as Appendix N.

The Training of Mechanical Engineers.

Public Works Department colleges and schools: Roorkee.

153. There are four engineering colleges in India which provide the training required by recruits for the Public Works Department. The largest is at Roorkee in the United Provinces, where it was originally established in 1847 to train the engineers and upper subordinates who were required in rapidly increasing numbers on the extensive system of public works, and particularly the irrigation canals, that were started soon after the province came under British rule.

Madras.

At an even earlier date (1794) a school for surveyors was started in Madras which ultimately developed into an engineering college in 1857. Thirty years, later it underwent extensive reorganisation and its staff was greatly strengthened. Little, if any, differentiation is made between the training given to civil and to mechanical engineers. Quite recently, an electrical course has been instituted and a Professor of Electrical Engineering added to the staff.

Sibpur.

The Sibpur Engineering College developed from University courses in engineering, which were started in 1858 by the Public Works Department and handed over in 1860 to the Presidency College. In 1880 this engineering branch was constituted a separate college and transferred to Sibpur, where it has since remained. The growth of modern industries in Bengal has greatly influenced its development, and the courses of instruction now provided are of a more general character than would be essential, if only the requirements of the Public Works Department had to be met.

Poona.

The College of Engineering, Poona, started in 1854 as the Poona Engineering class and Mechanical School. In 1866 it was affiliated to the University of Bombay and styled the Poona Civil Engineering College. Later, in 1879, classes in agriculture and forestry were added, and in 1880 the name was changed to "The College of Science." In 1907 the agriculture classes were removed; in 1911 the courses leading to the degree of B.Sc. were transferred to the new science institute in Bombay, and the name was again changed to that which it now bears. At the present time the courses of instruction lead up to the University examinations for the degree of B.E. (Civil) and B.E. (Mechanical). There are also classes for Public Works Department sub-overseers, mechanical apprentices and electrical apprentices.

There are also a number of less important schools of engineering, training chiefly for the Public Works Department, but including in their courses some instruction in mechanical engineering.

Defects of Indian system of training engineers.

154. In the past, the education of engineers has been too much influenced by the immediate requirements of the Public Works Department, without regard to the future or to those other interests in India which can be handled only by engineers. The higher branches of the engineering services in this country absorb but a very small proportion of the engineering students who pass through the colleges, and the rest enter the upper subordinate ranks or find private employment of a not very remunerative character. The greater part of the work done in each college is the training of upper subordinates, lower subordinates, surveyors and draftsmen. Students join the college classes in the hope of getting appointments as Assistant Engineers; but, failing these, they consider that they have a better chance as upper subordinates, if they have passed out of the colleges as engineer students and not as upper subordinate students.

In the four principal colleges, increasing attention has, in recent years, been paid to the provision of instruction in mechanical and electrical engineering; but the measures adopted are inadequate and are conceived on altogether too narrow lines to meet the needs, present and prospective, of a rapidly expanding industrial system. Indian civil engineers have done well in the Public Works Department and have established their claims to promotion to the highest ranks of the service; but in mechanical engineering which, outside the railway workshops, is mainly carried on by private enterprise, we find that, in the absence of a proper system of training, they have seldom attained to positions of importance or responsibility. In practically all the engineering workshops which we have visited, we found the same state of affairs existing with regard to the superior staff as we had seen in the case of foremen. The former, whether assistants or managers, were men who had been trained as mechanical engineers in Great Britain.

It is only in recent years that the Government engineering colleges have recognised that they ought to be something more than mere appanages of the Public Works Department; but so far, the attempts made to train students for careers other than those offered by service under Government, District Boards or Municipalities, have taken the form of alternative or additional courses of instruction, and until quite recently no radical reforms have been contemplated, much less introduced.

Necessity of providing for industrial developments.

155. Especially since the outbreak of war, various causes have attracted public attention in an increasing degree to the predominant importance which mechanical engineering is now beginning to assume in this country. The establishment of the manufacture of steel on the firm basis of commercial success brought into sight the possibility of further developments on a scale never before contemplated. It has not only encouraged English firms to consider the formation of branches of their own specialised industries in India after the war, but has given opportunities to Indian capitalists to take in hand schemes for various forms of engineering and metal manufacturing work. The production of zinc and copper from Indian ores has recently come within measurable distance of actual accomplishment, and has still further increased the scope of possible enterprise. The experience of the war itself has been responsible for a new attitude on the part both of Government and of leading industrialists. They realise that it is necessary to create in India the manufactures that are indispensable for industrial self-sufficiency and for national defence, and that it is no longer possible to rely on free importation of essential articles in time of war. We think it not out of place to observe here that the existence of this Commission and the discussions which have from time to time arisen out of the evidence given before it, together with the creation of the Munitions Board, itself a development of the Commission, have helped in the above direction. Finally, the attention of the educated public, and in particular of the large industrial employers, has been drawn to the inconveniences and dangers that arise from the entire dependence of India on imported personnel for the supervision of engineering industries.

System recommended in England for training mechanical engineers.

156. The education and training of engineers was the subject of an enquiry by a committee appointed by the Council of the Institution of Civil Engineers in 1903, on which committee all the important engineering societies were represented. Their report, which was published in 1905, embodies the collective experience of engineers belonging to practically every branch of the profession, and though in many respects the conditions in India are different from those prevailing in the United Kingdom, certain fundamental conclusions were reached which are entirely supported by the facts placed before us in evidence by leading engineers and industrial employers, and should be adopted in this country. In submitting their recommendations, the committee prefaced them by the statement that they were unanimous in their opinion that engineering training must include several years of practical work as well as a proper academic training. They considered :—

"(1) That the average boy should leave school when he is about 17 years of age; that much depends upon the development of individual boys, but the minimum age should be 16 and the maximum 18 years.

(2) That the practical training should be divided into two parts, and that the preliminary stage of practical training should consist in all cases of at least a year spent in mechanical engineering workshops.

(3) That during workshop training, boys should keep regular working hours and should be treated as ordinary apprentices, be subject to discipline and be paid wages.

(4) That nothing should be done in the form of evening study which would impose unnecessary strain upon the boys.

(5) That, as a rule, it is preferable to proceed to a technical college on the completion of the introductory workshop course; but that, in the case of boys intended to become mechanical engineers, it may be advantageous to complete the practical training before entering the college; but in such cases it becomes important that simultaneous education during practical training should be secured. Otherwise, the boys would lose seriously during four or five years' suspension of systematic study, and would be at a disadvantage on entering the college.

(6) That for the average student, the period of college study should be at least three years.

(7) That at least three to four years should be spent in practical training, inclusive of the introductory workshop course previously mentioned."

157. We are aware that this question has been discussed on other occasions, at times with the same, at others with somewhat different, results; but a study of these discussions has led us to the belief that the above-quoted conclusions may fairly be taken not only as the most authoritative expression of British engineering opinion at the time, but as still representing the general views of the profession. The methods pursued in this country, however, differ widely from the system suggested above. The age of boys when they join an engineering college in India is from two to three years higher than that recommended. Most, if not all, of the colleges prescribe a period of training in workshops after the completion of the theoretical courses, just as we have seen in the case of institutions giving a lower type of training; but even this period is much too short to be of practical value to mechanical engineers; no attempt is made to subject the students to regular workshop discipline, and they are not compelled to attend the full working hours. They go from shop to shop making notes and sketches, and watch others at work, but, as a rule, do nothing themselves. This course, such as it is, broadens the outlook of students who are intending to become civil engineers; but it is worse than useless as an initiation into the mechanical side of the engineering profession.

It has been objected that educated Indians will be unwilling to submit to the early hours and hard conditions of workshop training. This may, no doubt, have been the case in the past, but there are now numerous signs of a marked change in sentiment, and we feel confident that, if facilities are provided, increasing use will be made of them. There are difficulties in the way, we admit; but they are not so great as is often supposed, and can be overcome.

Proposals of the Commission for training mechanical engineers.

158. There is, thus, as we have seen, a very decided consensus of opinion among practical men that the ideal method of training mechanical engineers is to combine workshop practice and technical instruction as closely as possible. To attain this end in India the workshop has been imported into the college, but the results have not been altogether satisfactory. The atmosphere of the workshop cannot be obtained in the school, and the importance of this is so great that we are convinced that mechanical engineers must be trained in the workshops, receiving supplementary class instruction in technical schools alongside which should, of course, be of a more advanced nature than that which would be provided for foremen. That is to say, the mechanical engineer, by which term we mean the man who in after-life will be responsible for the design and construction of machinery and structural iron work of every kind, should be trained in a way analogous to that prescribed for the members of the labouring classes who will become artisans, and the boys of a higher social grade and with

a better general education who aspire to become foremen; but he should start in the workshop somewhat older and after a more prolonged general education. In the factory, he should be regarded as a workman and treated as such, and paid wages which should represent the market value of the work he does; but he should not spend the whole of his time in the workshops. Roughly, the time spent in the technical classes should be equal to one-third of the total working hours of the shops, but whether this be so many hours a day or so many days a week matters little and may be arranged to suit local circumstances. The main idea underlying our conception of the proper method of training mechanical engineers is thus a fundamental modification of the current practice in India; the chief training-ground should be the workshop, though the class-room is also indispensable.

Further training of mechanical engineers in special subjects.

159. After the period of apprenticeship is completed, and this should not be less than four years and may usually with advantage be five, those apprentices who desire to specialise should be provided for in one or more of the existing engineering colleges, where advanced courses of instruction will be given in such subjects as applied mechanics, electrical engineering, the physical sciences, hydraulics, the strength and properties of materials, and heat engines. It should be recognised that these students are adults seeking to gain knowledge for a very special purpose, and they should not be treated as undergraduates and forced to go through a rigidly prescribed course of instruction, such as is now provided in the engineering colleges of University rank. Our general idea is that colleges of this status should be made accessible to advanced students who wish to take special, instead of complete, University degree courses.

We have not specifically referred to the training of electrical engineers, because electrical manufactures have not yet been started in India, and there is only scope for the employment of men to do simple repair work, to take charge of the running of electrical machinery, and to manage and control hydro-electric and steam-operated stations. The men required for these three classes of work will be provided by the foregoing proposals for the training of the various grades required in mechanical engineering. They will have to acquire, in addition, special experience in electrical matters, but, till this branch of engineering is developed on the constructional side and the manufacture of electrical machinery taken in hand, the managers of electrical undertakings must train their own men, making such use as they can of the special facilities offered for instruction at the engineering colleges and the Indian Institute of Science.

Technological Training.

Expansion of engineering colleges into technological institutes.

160. It will be necessary in the immediate future for Government to consider the more general question of the part to be played by the existing engineering colleges and the Universities, in providing for the increasing need in India for scientific, technical, and technological training. We feel convinced that, as the development of the country proceeds, the number of students will increase and that, in consequence, at no distant date it will be found desirable to abolish the school departments of these colleges and to make provision for the education of subordinates in separate institutions, which, not being of University rank, will be placed under the control of the Directors of Industries. It is urgently necessary to prepare for a higher technological training, which will provide the means whereby the physical science students of the colleges affiliated to the Universities may learn to apply their knowledge to industrial

uses. The simplest way of meeting this demand would be to expand the engineering colleges into technological institutes by the creation of new departments. At present they are chiefly occupied with the training of civil engineers. We have just recommended that they should make provision for the higher technical instruction of mechanical and electrical engineers, and we anticipate that industrial expansion will justify the starting of departments of general technological chemistry, which, in each college and teaching University, will specialise to the extent necessary to meet at any rate the more prominent local needs. We regard it as certain that public opinion will demand that these colleges shall be connected with the local Universities and that the students shall be able to obtain University degrees. To this we think no serious objection can be raised, provided that the terms of association leave the colleges free to frame their own courses of study, reserving to the Senates of the Universities the right to prescribe which shall be selected as qualifying a student to enter for a University degree. The internal administration of the colleges should be controlled by a Board or Council, the members of which might be nominated by the Department of Industries, the University, and public bodies representing employers. This Council should have the privilege of delegating a certain number of its members to represent it on the Senate.

Imperial engineering colleges foreshadowed.

161. Up to this point our recommendations regarding industrial and technical education are such as should be carried out by provincial Governments; but, we think, it will be necessary ultimately, if not in the immediate future, to provide India with educational institutions of a more advanced character, which no single province could support or fill with students, yet which each province will need to a greater or less extent. For some time to come the demand for this higher training can best be met by the provision of scholarships to enable students to proceed abroad, but, as soon as our foregoing recommendations have had time to develope their full effect, it would be advisable to proceed further and establish imperial colleges of the very highest grade. Two at least would be needed, staffed with specialists of high reputation who must be provided with adequate equipment for both teaching and research work. One of these colleges should cover every branch of engineering, while the other should be devoted mainly to metallurgy and mineral technology, the developments of which are certain to be on a very extensive scale. Provincial colleges can only hope to secure the services of good, all-round men who would be employed mainly in teaching work; but, if the ideal of a self-sufficing India is to be completely carried out, specialisation must be provided for, and this can only be achieved in colleges with a large number of advanced students. We can hardly hope to serve any useful purpose by pursuing this idea further. Details will depend upon the actual state of things at the time when it becomes necessary to mature a scheme. We, therefore, refrain from elaborating any proposals of this nature and content ourselves with suggesting that they should always be kept in sight as the goal.

Scientific and technical societies.

162. Before leaving the question of higher training we desire to advert to one important matter. We consider that India suffers from the general absence of organisations similar to the great scientific and technical societies which have in many countries done so much to promote the professional education of their younger members. We have already had occasion to refer to an instance of the work of the English Institution of Civil Engineers in this direction, and we think that it would be greatly to the advantage of Indian engineers if a representative society were started. Our views on the subject, which we regard as one essentially for private initiation, are explained

in detail in Appendix H., and here we need only add that we in no sense limit our suggestion to engineering. Whenever the number of specialists in any branch of science or professional activity is sufficient to enable them to form an association to promote its development in India, their action in this respect should be supported in every reasonable way by the State.

The Victoria Jubilee Technical Institute, Bombay.

Proposed utilisation of engineering classes to supplement workshop training

163. Reference has already been made to the starting of the Victoria Jubilee Technical Institute in Bombay. During recent years it has developed a somewhat polytechnic character, and now provides courses of instruction in (1) mechanical engineering, (2) electrical engineering, (3) textile manufactures, (4) applied chemistry, and (5) plumbing and sanitary engineering. Most of the witnesses who have come before us with experience as employers of its students have spoken well of them ; but, so far as the training in mechanical engineering is concerned, ex-students are nearly all employed in subordinate capacities, and there is little probability that many of them will rise to high positions. The courses of instruction extend over four years, of which the last six months have to be spent on practical work. Enquiries made of the managers of workshops and factories in which these students received this part of their training did not convince us that the arrangements were of a satisfactory character. Moreover, the time allowed for practical training is too short. In view of the conclusions we have reached regarding the training of mechanical engineers, we cannot regard the work done in the Institute for this class of students as satisfactory. Instead, however, of abolishing these classes, it would be preferable for the Institute to associate itself more closely with the local engineering industries carried on in Bombay ; and it should not be difficult to frame a scheme whereby the Institute, in its new location at Matunga, will supplement the workshop training of apprentices from the railway and other workshops, thus performing locally the function of the technical classes which we have recommended in the case of the larger workshops. To a large extent, the popularity of the mechanical engineering classes is due to the law which prevails in certain provinces compelling owners of steam plants to place their boilers in charge of certificated men. If the suggestion which we make elsewhere that this law should be abolished is carried into effect, there will be undoubtedly less demand for instruction of the kind necessary to pass the specified Government examination. On the other hand, we hope that the forthcoming expansion of mechanical engineering will more than replace the loss of this artificial demand for what can only be described as a very imperfect training.

Technological courses : two years' practical course recommended.

164. These remarks do not apply to the technological courses which include (1) textile manufactures, (2) applied chemistry, and (3) plumbing and sanitary engineering. In these instances, we approve of the existing arrangements whereby the students receive a preliminary training before embarking upon practical work. In this view we are largely influenced by the fact that the classes are conducted throughout on lines as nearly resembling actual commercial practice as is possible in any teaching institution.

The spinning mill or the weaving shed is not an appropriate place in which to give instruction in textile mechanism, and practice in the working of the machines can be more easily arranged in a specially-equipped shed, where a great variety of single units is available. Knowledge and experience of this kind can be gained much more rapidly in the Institute than under practical working conditions in a mill, and there is no doubt that the young man who aspires to become a textile manufacturer, can best begin by going through one or both of the specialised courses of instruction provided by the Institute. Similarly, a preliminary knowledge of chemistry is essential to any one who intends to apply such knowledge to manufacturing processes, and the laboratory rather than the chemical works is the place in which the training should begin.

In regard to plumbing and sanitary engineering, most of the practical work consists of fitting up buildings in accordance with prepared plans, and before a young man can be sent out to do such work, he requires considerable skill in manipulating the materials employed, and some general knowledge of the sciences which bear upon sanitary engineering. It is also necessary that he should be able to prepare plans and estimates, and, without doubt, a knowledge of these matters and the requisite degree of craftsmanship can be attained most readily in organised schools.

165. We therefore consider that in respect of these technological courses, no changes are necessary; but we think that the training in the Institute should be followed by two years spent on practical work, before the full diploma can be obtained. The students should be apprenticed on leaving the Institute, and they should be given definite employment and paid a living wage. There will, no doubt, be difficulty at first in finding places for them. Employers of labour in this country have realised only to a limited extent that it is incumbent upon them to provide facilities for training the rising generation. To convince them propaganda work will, at the outset, be necessary. There are fortunately many Government workshops to set an example, and it should not be difficult to induce the owners and managers of private undertakings to follow suit.

Mining and Metallurgical Education.

Mining education: existing position.

166. Mining education in India occupies, as we shall explain below, a somewhat peculiar position. Two systems of teaching, applied to very similar material, are going on side by side, and there is a large concentration of mining employment on a single area—the principal coal field—while other forms of mining are scattered over the whole of India, and differ widely in character. For these reasons we have thought it necessary to discuss the subject in detail.

By far the largest demand for mining engineers and trained subordinates comes from the coal fields situated in the provinces of Bengal and Bihar and Orissa. The forms of mining in other parts of India are often only mere quarrying or, where actual mining is practised, are either so highly specialised as to necessitate a practical training which cannot be given in India, or are only on a small scale. It is clear, then, that for a long time to come, India must look for mining education to an institution or institutions based on the requirements of the Bengal coal field.

(a) Sibpur College courses.

The provision at present made for mining education comprises—(1) courses at the Sibpur College, (2) evening classes on the coal field. The senior Sibpur course is one of two years, which follows a preliminary two years' training leading up to the examination for sub-overseers. The students are trained in mine surveying, electricity, colliery mechanics, mining and chemistry, and are taken into camp on the coal field for six weeks in the cold weather. At the end of this course they obtain a diploma, after passing an examination. Recently, however, the Government of India have approved of the reduction of the two years' mining course to a single year, conditionally on the students who take up the course having previously passed the overseers' examination and spending at least eight weeks in a colliery during the college vacation. A preparatory course of one year is also being provided. Under the previous conditions it was not easy for students from other provinces than Bengal to obtain admission, though it is only fair to add that very few attempted to do so. Accommodation was limited, and the Local Government stipulated that no qualified Bengali student should be excluded. The necessity for passing the sub-overseers' test before entry was also a difficulty in the case of students from certain provinces, where training of this class was given only to a very limited extent. These obstacles have now, it is claimed, to some extent been overcome, and there are at present (1918) five outside students taking the course. For some years past, the removal of Sibpur College has been under contemplation, and Government has been reluctant to incur increased expenditure on the existing institution. Accommodation is thus still inadequate.

(*b*) Evening classes on the coal field.

The evening classes are held at five centres on the coal field under the control of a joint board, on which the mining interests and the Governments of Bengal and of Bihar and Orissa are represented. The cost of these classes is met by the two Governments.

The results of the examinations held at Sibpur and in connection with the evening classes are shown below—

	1912-13.		1913-14.		1914-15.		1915-16.		1916-17.	
	Appeared.	Passed.	Appeared.	Passed.	Appeared.	Passed.	Appeared.	Passed.	Appeared.	Passed.
Sibpur College .	4	2	4	2	3	3	3	3	5	5
Evening classes .	40	17	26	16	24	12	26	17	27	26

The average attendance at the evening classes in 1915-16 was 120, and that of the vernacular evening classes was 264.

Recent proposals for improvement.

167. In 1913-14, a committee, which met under the presidency of Sir D. Macpherson to advise on the question of mining education, recommended the opening of a school of mines at Dhanbaid and the improvement of the existing evening classes on the coal field. The school was to cost Rs. 5,56,000 initial, and Rs. 98,000 recurring, while the expenditure required for improving the evening classes was estimated at Rs. 1,51,000 initial and Rs. 71,000 recurring, towards which latter figure it was hoped that the mining industry would contribute. In 1914-15, a committee consisting of Messrs. Adams, Chief Inspector of Mines in India, Roberton, Professor of Mining at Sibpur, and Glen George, Mining Engineer, after examining the system of mining education in England, submitted a report which was in general agreement with the proposals of the Macpherson Committee.

Insufficiency of evening classes as sole means of instruction.

168. Two main points arise for consideration in connection with the above proposals—(1) would an improvement of the existing evening classes suffice, without a school of mines? (2) if a school of mines is considered necessary, where should it be located?

With regard to the first point we observe that the lads who attend the evening classes are in most cases deficient in general education, and this fact, coupled with the necessarily limited range of instruction given, render these classes unsuitable for training first-class colliery managers. Out of the nine men who obtained first-class certificates in 1916, six men came from Sibpur. It is true that in England the larger proportion of colliery managers have obtained their mining education at evening or other similar classes; and of the comparatively small number of students who are found at the various schools of mines, most seek employment either in metalliferous mines, or as consultants, Government inspectors, and geologists. But the position in England has changed; the examination for the manager's certificate has been made more severe, and mining schools of a different type are springing up, in one case financed and controlled by the mining interests themselves; this type is therefore likely to take a large share in producing colliery managers. We think it necessary that, although the evening classes require improvement, some form of mining school should be provided for holders of first-class certificates, *i.e.*, certificates entitling a man to hold charge of a colliery raising over 1,800 tons a month.

Location of the proposed school of mines.

169. We now come to the question of the location of the school of mines, and we may consider whether a self-contained mining school on the coal field itself is preferable, or whether teaching might not be provided in a department of an existing engineering college, such as Sibpur. The latter scheme would be cheaper; it would bring the students into contact with lads studying for other branches of engineering, which is advantageous; and a well-known institution like Sibpur would possess better and more established traditions than any new institution. Finally, as we have already pointed out, Sibpur already produces most of the successful candidates for first-class certificates.

On the other hand, there are disadvantages attaching to the Sibpur institution. Visits to coal mines from time to time during the course to explain points of practice can be completed from Dhanbaid within a few hours; from Sibpur they take not less than 36 hours. The staff of an institution on the coal field is in close touch, not only with the latest developments of the industry, but with employers and managers, a great advantage to the students both while under training and afterwards when seeking for employment. A sub-committee appointed in 1916 to consider the future of the Sibpur mining class, reported that it would be very hard for teachers at Sibpur to secure practical training for students in collieries, while the staff at a school in the coal field could do this with comparative ease. To keep the school in close association with the industry is also a matter of importance. Finally, the staff of a school on the coal fields can maintain intimate relations with those of its students who are taking the practical portion of their course at one or other of the mines.

170. So far, therefore, as the choice lies between Sibpur and Dhanbaid, we prefer the idea of a self-contained mining school on the coal field; but are prepared to agree that, instead of the course of three years at the school and twelve months' preliminary practical work proposed by the Macpherson Committee, students may take their practical course at the end of their first year. We consider it essential that students should pass a reasonable period in underground work.

We are conscious of the heavy cost which such an institution is likely to entail relatively to the number of the students, at any rate for the first few years of its existence. The Macpherson Committee did not anticipate a larger number of students at first than 48, an estimate which might, however, now be increased. But we consider that the necessity of training mine managers in India and of making the country so far independent of imported experts, is strong enough to warrant the expenditure. The number of students attending the course at Sibpur is increasing; and if the proposed school is open to the whole of India, this should bring in still more candidates. The argument for an inter-provincial institution lies, not in the desire shown by the different provinces of India to train their own men to manage their own mines, but in the absolute necessity of extending the area of recruitment for the mining profession as widely as possible, in order to supply this urgent need by the most suitable men from every part of the country. The main advantage would, it is true, be reaped by the coal fields of Bengal and Bihar and Orissa, and candidates from these provinces would retain the undoubted advantages which proximity to the school of mines must always give. But there should be no preference shown to local candidates and admission to the school of mines should depend on suitability alone.

171. There is, however, a possible third course, besides a school of mines at Dhanbaid, or a mining class at Sibpur. Various proposals have come to our notice for research and training in metallurgy and other allied forms of technology, proposals which we have discussed more fully in Chapter IX. An institution at Sakchi teaching the above subjects would naturally also include certain forms of mechanical engineering, in view of the unrivalled opportunities which would be provided by the group of works springing up near that centre. Many of the science subjects which will have to be taught as a foundation in such an institution will be common both to mining and metallurgy; these will include geology and mineralogy, physics, chemistry, mathematics, and mechanics; and among practical subjects, mechanical and electrical engineering. A considerable saving in cost could be effected, and a more efficient staff and equipment provided, by combining in the same institution the higher forms of training for mining and metallurgy. We recognise, however, that a school of mines and metallurgy at Sakchi, though preferable to classes at an unrelated centre like Sibpur, would be in less intimate touch with the coal-mining industry than a school at Dhanbaid, and, in view of the great desirability of keeping the mining industry in the closest possible relations with mining education, we support the proposal to establish a school of mines at Dhanbaid. Until this is done, the Sibpur classes should be maintained and teaching steadily improved on lines that would permit of the transfer of the classes to Dhanbaid. The Sakchi institution would naturally specialise in metallurgy and related forms of applied chemistry which would constitute a group sufficiently wide in range for a high-grade institution.

The proposed Sakchi school for metallurgical training.

172. The Government of Bihar and Orissa have consulted us about a proposal to start a technical school at Sakchi for the metallurgical industries which are likely to develope in that neighbourhood in association with the works of the Tata Iron and Steel Company. We are much impressed by the possibilities of this centre, and the great opportunities which it will offer for employment to men possessing a technical training. We consider that there will be ample scope for a school of the type proposed, both before and after the starting of still higher institutions for specialist training and for research; and we have conveyed to the Bihar and Orissa Government our general approval of their scheme.

Miscellaneous Educational Proposals.

Navigation and marine engineering.

173. We have elsewhere in our report indicated ship-building as a potential Indian industry of the future, though one that perhaps will not materialise for some time unless the necessary plates, sections, and engines are imported

from abroad. Be this as it may, there is no reason why India should not be ready to man her own ships when they are built. She has already for many years past provided excellent crews for the ships of other nations; and, given facilities for education in nautical subjects and marine engineering, she should in course of time be able to supplement these crews, at any rate in the coasting trade, with capable officers and engineers. The supply of such men from Britain must be very short for many years to come, if not always in future, and facilities for recruitment in India would do much to render her self-supporting in case of another great war. There have been frequent demands, especially on the Bombay side, for training of this nature for young Indians, but we have been unable to obtain any authoritative or helpful information as to the lines on which the subject could be taken up, and are, therefore, unable to dilate upon it. It requires expert knowledge of a particular kind, and could only be satisfactorily handled by a committee specially appointed for the purpose, as it would necessitate the establishment of at least one school of navigation in the country and the provision of one or more training ships.

Commercial education.

174. During the course of our tours, the necessity for special schools and colleges of commerce was frequently brought to our notice by Indian witnesses, who were in many cases men with considerable practical experience. On the other hand, some European witnesses expressed grave doubts as to the utility of such institutions and insisted that only in an office could the training be given that would turn out a useful business man. This divergence of opinion is, we conceive, largely due to the different standpoints from which these two classes regard the question. We are inclined to think that the European evidence which we have received is not based upon a sufficiently wide examination of the circumstances in which trade and commerce are carried on by Indians, and a full acquaintance with the educational system which has grown up in the country.

It is obviously beneficial to any Indian about to engage in commerce, who desires to rise above the rank of a clerk, that his education should be specifically adapted to his career, and should also be carried to the University stage. The greatest benefit from a high commercial training is likely to be received at present by sons or relations of commercial men who intend to enter the family business; this type was well represented in the Sydenham College of Commerce of Bombay. The school of commerce should provide teaching in shorthand, type-writing, the methods of book-keeping and précis writing and, above all, in modern English. These subjects may be regarded as essential for the routine working of an office, but to them should be added instruction in the mechanism of banking, exchange, and foreign trade, together with such subjects as commercial geography and a detailed study of the economic resources of India. There are already in India a number of schools of this type, some of which are efficiently managed; but the majority do little more than teach shorthand and type-writing, and make an attempt to impart a knowledge of book-keeping that is of little or no practical value. Most of these schools take the form of evening classes and are frequented by young clerks.

175. Higher commercial education is still in its infancy in India, and the only institution of University rank that has so far been started is the Sydenham College of Commerce in Bombay, which prepares undergraduates of the University for the examinations leading to the degree of Bachelor of Commerce, instituted by the Bombay University in 1912. Sufficient time has not yet elapsed to enable a definite opinion to be expressed as to the extent to which the aims of the founders are likely to be realised; but so far, the students who

have passed out have been well received by the Bombay mercantile community, and have obtained employment on much better terms than their contemporaries who have taken the ordinary Arts course. The college is popular and it is likely to continue so, until the supply of commercial graduates is in excess of the demand. This cannot happen so long as the Sydenham College remains the sole commercial educational institution of University rank; but there is a strongly expressed desire for similar colleges in other parts of India, and we think that the other Indian Universities might well consider the possibility of satisfying this demand. Industry and commerce are bound to go on expanding rapidly, and they will be glad to pay a higher price for more efficient employés. The practice of more up-to-date methods of business and account-keeping is certain to spread into the mofussil, as familiarity with modern trade and industry increases. An alternative University course, in any case, has the advantage of widening the educational basis, and, provided the University commercial courses supply as good a training to the mental faculties as do the present Arts courses, they deserve encouragement on their own merits, as part of the general educational scheme of the country. The relations between the governing bodies of colleges of commerce and Universities should be exactly similar to those which we have suggested for technological institutions, as outlined in paragraph 160. We attach great importance to the co-operation of business men in the control and this, we think, can be secured in the way there indicated.

The provision of teachers for industrial and technical education.

176. The provision of teachers for the various grades of education described in this chapter is not a question that needs discussion at any great length. For instruction in the higher branches of engineering and technology, we must look to the University colleges and technological institutes to provide teachers. They will be trained under the influence of men of high attainments engaged in original work, who will present their subjects in a way that will evoke a real and abiding interest among the students, and ensure that men who pass through their classes are thoroughly imbued with a clear knowledge of their subject and of right methods in dealing with it. Some of these will be fitted for teaching work by a natural capacity for the clear exposition of ideas. It must be remembered that research and what may be termed 'workshop practice' are themselves the best possible training for those faculties which a teacher largely uses, and that in consequence, in the case of subjects outside the line of general education, special training schools or colleges are unnecessary and even likely to be a disadvantage. There is not the least probability that educational appointments will fail to attract men who have been trained for technological or industrial work. Compared with factory life, the work of a teacher in a school or college offers inducements to a very large number of persons who prefer a certain amount of ease and freedom from worry to the strenuous existence, which is essential to success in manufacturing concerns. Appointments as teachers will naturally be sought after by men who feel that they have some special aptitude for such work, and provided suitable selections are made, actual experience in teaching will ultimately produce the high type of men required.

It is only when we come to industrial education, whether in organised workshops or in schools for cottage workers, that difficulties are likely to arise. The artisans from whom the teachers of craftsmanship will be drawn, have hitherto as a class been lacking in general education and have learned their craft on purely empirical lines. We have, however, provided an adequate remedy in the superior inspection staff and in the trained managers and supervisors who would be placed at the heads of these institutions. The latter should be specially recruited at first, though in the case of schools for iron work and carpentry they may subsequently be obtained from the students who have passed through the proposed classes in mechanical engineering and have obtained some degree of practical experience afterwards. It would be the business of these men to train their own staff, and experience has shown that in a few instances at least they have been able to do it. Skill in craftsmanship is acquired by example and by practice rather than by precept, and those who are responsible for the training of artisans will see that the methods employed are correct, that the appliances in use are suitable, and that the instructors possess the necessary skill to enable them to show their pupils how work should be done.

The Control of Technical and Industrial Education.

Arguments for control by Department of Education.

177. Although we have proposed to place the control of technical and industrial education under the Departments of Industries, we are aware that, especially in regard to the former class of education, there is a strong body of opinion in favour of retaining it under the Director of Public Instruction

This opinion appears to be based on the following grounds; firstly, that the Department of Education cannot be dissociated from these forms of teaching without loss, on account of the importance of method, with which that department is naturally more familiar than any other; secondly, that any form of teaching which is removed from the Department of Education may lose prestige in the popular mind; thirdly, that all technical and industrial training must include some degree of general education, with which the Department of Education is organised to deal.

Arguments for control by Department of Industries.

178. In meeting these arguments, it must be borne in mind that, in the first place, education designed to produce men who will readily find industrial employment must in any case be very largely controlled by an agency which, by its training and constant association, is in touch with the industries that will furnish that employment. Both in devising educational schemes and in ensuring by inspection that they are actually followed in working, this class of agency must have a predominant part. It is not enough to appoint a man with an industrial training as an inspector of industrial schools; he must throughout be kept in touch with industries and industrialists, or the training given will soon degenerate. Speaking generally, the different forms of technical and industrial education have as their object either the training of a man who will ultimately direct industrial operations or the production of a workman skilled in some form of handicraft. Of the success of the teaching, the private industrial employer must remain the ultimate judge. The Department of Industries is the only Government organisation capable of entering into his point of view, and the only one with which he can readily associate himself. It is the only agency of any kind that can correlate the training to the requirements as ascertained by it. Almost every educationalist of standing who appeared before us was in general agreement with these views.

Our conclusions are strengthened by a consideration of the nature of the various forms of technical and industrial education, the necessity of which has been indicated in our report. In the case of industrial schools, where craftsmanship is the all-essential feature of the training, the small amount of elementary general education that is required can easily be supervised by any person of ordinary intelligence, whilst the teaching of craftsmanship must be provided and controlled by an agency which knows from practical experience the type of employé required by an industry, and can judge if the requirements have been fulfilled. This the Education Department is not likely to be able to do, judging by the results of its past efforts in this direction. In the case of artisans who are trained in shops, the same arguments apply; and it will be easier for a Department of Industries to maintain the necessary relations with railway or private shop managements. The superior training for foremen, which will be given under somewhat similar conditions but to better educated persons, and will involve a greater amount of theoretical teaching, seems to fall into the same category; the only question is whether the theoretical teaching requires any degree of control by experts in the methods of imparting teaching generally. The danger of allowing the theoretical to outweigh the practical aspect of the training must be remembered. It must also not be forgotten that the experience of industrial and technical training in other countries has evolved its own theories, traditions and expert teachers, of which the Department of Industries can make a more understanding use than the Department of Education. The control of the foregoing forms of education should, therefore, rest with the Department of Industries; but the advice and co-operation of the Department of Education should be obtained in respect of general educational subjects, both in framing the courses of instruction and in deciding on the methods of teaching and inspection.

It is only where some form of higher theoretical instruction is needed, such as that proposed by us for engineers and specialised technologists, that any question arises of the participation of the Department of Education in the control. Part of the education of engineers and the entire training of men for posts of specialised technologists should, we have suggested, be given in institutions of collegiate rank. Their expenditure should be administered and their teaching controlled by joint boards, on which the Department of Industries, the local University and employers should be represented. We have already explained the relations which should exist between the Universities and these colleges.

Necessity for imperial visiting officers.

179. We desire here to draw attention to the great diversity of practice which has hitherto prevailed in the methods of imparting industrial and technical education of all kinds in different parts of India, a diversity which has unfortunately permitted the existence of much inefficient or misdirected teaching. We think it necessary, for some time at any rate, to arrange for the provision of a system of regular visits by specialist officers of the Imperial Department of Industries. There is at present in the various provinces no generally accepted tradition of correct methods in these forms of teaching, and we think that Local Governments and Departments of Industries would be greatly assisted in their efforts to create one, by occasional visits from imperial officers, whose functions would be merely advisory, and would be confined to placing their notes and observations before the Local Governments for consideration. The specialist visitors would form a convenient channel for transmission to one province of useful experience acquired by another, and this would enable Local Governments, while retaining complete control of their own industrial and technical education, to profit by the knowledge gained elsewhere.

CHAPTER XI.

COMMERCIAL AND INDUSTRIAL INTELLIGENCE.

Objects of a Commercial Intelligence Department.

180. In dealing with this question, we have had the advantage of perusing two recent despatches of the Government of India to the Secretary of State, proposing the re-organisation of the Commercial Intelligence Department and the appointment, which has since been made, of an Indian Trade Commissioner in London. These despatches have amply demonstrated the importance to Government of full and frequent information regarding commercial developments and requirements, and of the maintenance of close touch with such organisations as Chambers of Commerce and Trades Associations. We have also had complaints from many of the witnesses whom we have examined that there exists no clearly defined channel through which information on commercial matters in the possession of Government can be communicated, whether publicly or to individual applicants. There is, moreover, a general feeling that the collection, careful analysis and judicious distribution of commercial and industrial intelligence is a necessary feature of Government policy both in war and peace. The question has not hitherto been so treated as to afford Government a sufficient basis for the encouragement of industries in India or for political and diplomatic action abroad. With this end in view, we suggest a scheme whereby commercial and industrial intelligence may be organised on lines that will assist this country to become better equipped for the industrial struggle.

Necessity for collection of statistics by an expert agency.

181. In designing this organisation, we have had before us these two main points; first, the importance of having the information collected and the statistics analysed and expressed for public consumption by experts who have concrete ideas as to the use which can be made of them by practical industrialists and commercial men; second, the necessity of adopting a system which will enable these statistics to be issued in a form that will make them readily accessible to the commercial public. With regard to the first point, we consider it to be of prime importance to insist that, where a specialist department concerned with industries exists, it should handle the statistics and information relating to those industries. Unless this be done, irrelevant data will be collected, essential facts will be overlooked, and inaccuracies will follow from inexpert interpretation of trade terms. Several instances have been brought to our notice in which statistics regarding articles of unlike denomination were added together to make totals, and others in which failure to recognise the meaning of trade terms resulted in the compilation of figures which were either useless or misleading. Constant association with the general economic position of his industry is the only means that will render the industrial specialist a safe adviser to Government on commercial matters and enable him to direct his researches with a view to anticipating possible dangers. We consider it advisable to emphasise the commonplace that commercial statistics and intelligence are intended to serve as the basis of an active policy, and not merely as a means for explaining changes years after they have occurred. If handled by the expert, such figures will serve as a timely warning against attempts of aggressive nations to capture our trade, or to determine its direction in their own interests. To show the value of having statistics collated and analysed by appropriate specialists, we may cite the Railway Adminis-

tration Report and the Quinquennial Review of Mineral Production as instances bearing differently on questions of administration and policy.

The information which we include under the head of commercial and industrial intelligence will consist of the following :—

(1) statistics and other information regarding the movement of internal and overseas trade ;

(2) statistics and other information regarding the production and working of Indian industries ;

(3) information regarding trade usages in India and abroad, and the tariff and industrial policy of foreign nations.

Collection of statistics and information by provincial agency.

182. Our proposals relating to the provincial Departments of Industries contemplate that their Directors should qualify themselves as advisers to their Governments in matters relating to trade and commerce, and we have proposed that it should be one of their definite duties to supply advice and information to the public in regard to existing or new industries. Both for this reason, and in view of the considerations adduced in Chapter XII, it is obvious that they will have to maintain intimate relations with the manufacturers as well as with the merchants of their provinces, and to study and interpret all the statistical information which is of use in the conduct or administration of commerce. The staff of each provincial Director should include experts to deal with special problems, and, as there will be representatives of the department in every part of the province, it will be possible to maintain current and continuous records of what is going on in it.

Control of Department of Commercial and Industrial Intelligence.

183. The information comprised under the head of commercial and industrial intelligence obviously includes matters of interest to Government both on the commercial and industrial sides, as well as to private traders and industrialists, from whom enquiries may be expected on a wide variety of subjects, including requests for information on technical matters. If our principle be accepted that the statistics and intelligence relating to industries and commerce can be handled effectively only by the specialists who conduct the various forms of research and practical work intended to extend and develope Indian industries, it naturally follows that the figures for production as well as those for trade should be collected and analysed by the same organisation. On the whole, therefore, there is a distinct balance of advantage in favour of placing the whole of this work under the general control of the Department of Industries and in the hands of a single officer, whom we would designate the Director of Commercial and Industrial Intelligence. In consequence of their imperfect knowledge of the working of Government, firms and individuals who are anxious to obtain information with regard to trade movements, sources of production, suitable raw materials and technical processes, will often come to this officer in the first instance for information. It is, however, extremely important to keep in mind the harm that may be done, should any single officer give information on subjects in which he is not a technical or commercial expert. Thus an important function of the Director of Commercial and Industrial Intelligence would be to refer applicants for information and advice to the appropriate departments of Government from which these can be obtained at first hand. The Director should be a member of the Imperial Industrial Service which we propose in Chapter XXII, and his headquarters should be at Calcutta.

Special Officers for Calcutta and Bombay.

184. We consider that special commercial intelligence officers will be required for Calcutta and Bombay. These two large cities contain trading interests which involve such extensive relations with other provinces and foreign countries as to render necessary, at any rate for some time to come, the appoint-

ment of special officers working under the provincial Directors of Industries but communicating direct, when necessary, with the Director of Commercial and Industrial Intelligence. In other provinces the Director of Industries will not have such highly organised centres of trade to deal with and should be able, we think, to keep himself fully in touch with local developments.

Method in which statistics and information should be dealt with by imperial agency.

185. The bulk of the information with which the Director of Commercial and Industrial Intelligence would deal, would be obtained by him as a routine matter from the provincial departments, including the special provincial officers for commercial intelligence whom we have proposed for Calcutta and Bombay. The remaining sources of statistical information would be the Customs Department, the Railways, and other agencies which collect these figures at present. They should be published without comment in the first instance by the Director of Statistics when compilation on an imperial basis is required; in other cases by provincial Directors of Industries or by the other collecting agencies. These last will be advised by the expert authorities, imperial or provincial, as to the form in which the information should be tabulated. The advice of local committees of business men will be of assistance in this respect. The statistics should, where necessary, be interpreted and commented on by expert departments, where these exist, or, in their absence, by the Director of Commercial and Industrial Intelligence or by provincial Directors of Industries. It will be clear from what we have said above that the Director of Statistics should be a compiling officer only, and that he should not comment on statistics with which his relations are merely arithmetical.

Statistics of production and employment.

186. Information regarding production and employment has been in the past exceedingly defective. In the case of production, official figures have been confined almost entirely to the main industries, whose representative associations make it their business to collect them. This is a practice that should receive every encouragement, and Government should co-operate with such associations, helping them in the collection of their figures, where help is necessary, and obtaining their advice regarding the figures of interest to the trade which Government collects itself. Where no suitable associations exist, the collection of statistics of production should be taken up by Government through provincial Departments of Industries, to the extent that may be considered practicable and useful in each case. We recognise the difficulties that exist, and the necessity of leaving details to be worked out by the industrial organisation of the future.

Statistics regarding employment, including occupation and wages, have hitherto been of little use, partly because labour was not willing to move freely, partly because the figures were out of date when published and were often injudiciously selected. In the case of unorganised industries, the definitions of the various classes of labour were not sufficiently precise, with the result that wages appeared to range between very wide limits. In future, the increasing demand for labour and its increasing fluidity will make information of this class of much greater importance to employers. It need not always be statistical in form, so long as it is reliable and up to date. A report that a certain class of labour is seeking employment in a particular district, if promptly issued, is of much more use than a statement of the wages it drew last year. The information which local Departments of Industries should be in a position to supply ought to be of more value to employers than that available hitherto.

General summary of proposals.

187. The effect of these proposals on the way in which information, especially of a statistical nature, so far as it is of interest in connection with industries, should be collected, compiled, published and commented on, is exhibited in the accompanying table.

—	Agricultural.	Forest.	Rail-borne Trade.	Customs.
Collected by	Director of Agriculture or Land Records, who forwards to Director of Industries for record and use.	Chief Conservator or Conservator of Forests, who forwards to Director of Industries (local) for record and use.	Railways, who forward to Director of Industries for provincial totalling.	Collector of Customs, who forwards to Director of Industries (local) for record and use.
Compiled by	Director of Statistics, who forwards to Director of Commercial and Industrial Intelligence for record and use.	Director of Statistics, Inspector-General of Forests.	Director of Statistics.	Director of Statistics.
Published by	Director of Agriculture or Land Records (local). Director of Statistics (imperial).	Provincial Forest Department (local). Inspector-General of Forests (imperial). Director of Statistics (imperial).	Director of Industries (provincial). Director of Statistics (imperial).	Collector of Customs (local). Director of Statistics (imperial).
Commented on by	Director of Agriculture or Land Records (local). Suitable Agricultural Officer under the Government of India (imperial).	Provincial Forest Department (local). Inspector-General of Forests (imperial).	Director of Industries (local). Director of Commercial and Industrial Intelligence (imperial).	Collector of Customs (local). Director of Commercial and Industrial Intelligence (imperial).

—	Mineral.	Road and river traffic.	Production.	Employment.	Prices of articles of industrial importance.
Collected by	Director of Industries.	Director of Industries.	Director of Industries.	Director of Industries.	Director of Industries and Director of Land Records.
Compiled by	Chief Inspector of Mines.* Director of Geological Survey. Director of Statistics.	Director of Statistics.	Director of Statistics.	Director of Statistics.	Director of Statistics.
Published by	Director of Geological Survey (imperial). Director of Statistics (imperial).	Director of Industries (local). Director of Statistics (imperial).	Director of Industries (local). Head of technical department (where such exists). Director of Statistics (imperial).	Director of Industries (local). Director of Statistics (imperial).	Director of Industries (local). Director of Statistics (imperial).
Commented on by	Director of Geological Survey (imperial). Chief Inspector of Mines.*	Director of Industries (local). Director of Commercial and Industrial Intelligence (imperial).	Director of Industries (local). Director of Commercial and Industrial Intelligence or head of technical department (where such exists).	Director of Industries (local). Director of Commercial and Industrial Intelligence, or head of technical department (where such exists).	Director of Industries (local). Director of Commercial and Industrial Intelligence or head of technical department (where such exists).

* For mines under the Mines Act.

Note :—' Collect ' refers to collection of figures in a province or local area and the production of provincial or local totals.

' Compile ' refers to compilation of provincial totals into Imperial totals.

Crop forecasts.

188. Commercial men have emphasised to us the importance of the prompt issue of accurate crop forecasts. It would appear that these are not at present altogether satisfactory, especially those relating to the jute crop, which presents peculiar difficulties, chiefly owing to the fact that the bulk of the crop is grown in areas under the Permanent Settlement where no village records are maintained. The preparation of forecasts is a highly technical business which ought to be entrusted, as soon as possible, to the officers of the Agricultural Department, and their value must largely depend upon the amount of time which Directors of Agriculture and their staff can devote to the subject. As we have had occasion to remark elsewhere, this service is very much undermanned, and the accuracy of these returns may be expected to improve with the development of the department. We do not approve of the present practice whereby the Director of Statistics, as compiling officer, has to undertake the responsibility of amending the forecasts of provincial officers. Such a duty, we consider, would be more appropriately performed by some responsible officer with general experience of Indian agricultural conditions.

The Indian Trade Commissioner in London.

189. We think that in order to complete the organisation necessary to provide the people of India with information in regard to industrial and commercial matters, the recent appointment in London of an officer of the Indian Government as Trade Commissioner was a very necessary step. He will represent Indian trade interests, and his principal function will be to stimulate the development of the Indian export trade, by directing attention to fresh markets and by promoting the establishment of new commercial relations likely to be beneficial to India. He should also assist the imperial and provincial Departments of Industries by answering definite enquiries.

An experienced officer, who exercised the functions of Indian Trade Commissioner in London for a few months during the winter of 1914-15, under by no means favourable conditions, stated before us that the appointment was greatly appreciated, that produce brokers in London and manufacturers in the country freely applied to him for information and advice, and that these references led in many cases to actual business. There cannot, therefore, be any doubt that, if this appointment form part, as we contemplate that it should, of an organised scheme for the promotion of industries and commerce in India, it will prove to be one of growing importance. The office of the Indian Trade Commissioner should be in the City of London, so as to be as close as possible to the business houses with which he will chiefly have to deal. Manufacturing and commercial firms in India usually find it necessary to have London correspondents, and there is no doubt that Directors of Industries will find their work greatly facilitated by the presence of an officer in London to whom they can refer whenever necessary. Hitherto such enquiries have had to be addressed either to the Commercial Intelligence Branch of the Board of Trade or to the Imperial Institute, and although assistance may have been obtained in this way, the field of usefulness is limited, if only by the fact that neither of these bodies can command the services of men with up-to-date experience of Indian trade and commerce.

The appointment of Indian Trade Commissioner, like that of the Director of Commercial and Industrial Intelligence in India, should be included in the cadre of the Imperial Industrial Service, and it should ordinarily be held by an officer of that service deputed to England for the purpose. The experience gained by an officer holding this post should greatly enhance his value when he returns to India. The tenure of the appointment should usually be for a period of five years, and, though at first it may be held by an officer of the status of provincial Director, we recognise that it is likely to increase greatly in importance. The Trade Commissioner should be assisted by members of the Agricultural, Forest and Geological Survey Departments, in order to supply first-hand information regarding the chief raw products available in India. These officers should be temporarily seconded from their own services for comparatively short periods, so that the knowledge of Indian conditions in the Trade Commissioner's office may be always abreast of the times. It is essential that they should have sufficient experience and status to enable them to give reliable opinions on questions of fact, and that they should be sufficiently junior to turn their experience to useful account on their return to India; the appointment of officers of about ten years' service should meet these conditions.

We are of opinion that the Trade Commissioner should devote special attention to the needs of small Indian exporters and capitalists, who desire information regarding openings for foreign trade, and assistance in obtaining plant for their enterprises. We regard the appointment of an Indian assistant to the Trade Commissioner, which was made last year, as a useful step in this direction.

Indian trade representatives abroad.

190. The desirability of establishing Indian trade agencies in other countries, such as East Africa and Mesopotamia, with which there is likely to be considerable business after the war, should also be examined.

The Indian Trade Journal.

191. In addition to the supply of specific information to individual applicants, both the imperial and provincial Departments of Industries will be able to furnish the public with much useful information as the result of their enquiries and experiments. Hitherto, this has been attempted either through the agency of the Indian Trade Journal, by means of bulletins published locally or by reports submitted to Government which have been made available for subsequent publication by the press. This practice should be adopted more extensively in future, and to this end care must be taken to keep in close touch with the press and to ensure its co-operation, which will, we feel certain, be readily forthcoming. Some witnesses, but not many, expressed their approval of the Indian Trade Journal. Others described it as mere "scissors and paste." Our own consideration of the case leads us to the opinion that it should be discontinued, and that all official information should be issued by the Director of Commercial and Industrial Intelligence in the form of bulletins based on information derived from the imperial and provincial departments. In the case of some technical departments, the outturn of literature may be sufficient to justify the maintenance of independent special series. Bulletins should be printed in a form convenient for record, and each should deal with only one subject. They might then be issued periodically in packets to those bodies and individuals entitled to receive them, the list of which should be regularly revised and brought up to date. To the general public, they should be available at a moderate charge, either singly, in groups, or in complete sets.

The question of the publication of any of these bulletins in the vernacular and of the selection of the vernacular itself is for Local Governments to decide.

CHAPTER XII.

GOVERNMENT PURCHASE OF STORES.

Failure of existing rules to secure local purchase to adequate extent.

192. Witnesses qualified to discuss the subject were, almost without exception, strongly of opinion that Government could do much to assist the development of industries in India by the adoption of a more liberal policy in regard to the purchase by public departments of such articles as are, or can be, manufactured in the country. It is true that the rules regulating these purchases have been amended from time to time, mainly in the above direction, and it was not so much the prescriptions themselves which were the subject of complaint, as the way in which they have been administered.

But from the enquiries that we have made, and from information privately received, we have come to the conclusion that the manufacturing capacity of the country has been far from sufficiently utilised by Government departments in the past, and we believe that the somewhat radical changes which we now propose will considerably stimulate industrial progress.

Those of our members who had the opportunity, when working with the Indian Munitions Board, of scrutinising the indents on the Stores Department of the India Office, found numerous instances in which articles were ordered from England, which could have been supplied by Indian manufacturers equally well both in respect of price and quality, if the latter could have relied on an established Government practice of local purchase. It was also observed that there was a totally unnecessary diversity in orders for the same class of articles, which could easily be avoided by the adoption of standard patterns or types, only to be deviated from when there are express reasons for doing so. This would reduce the number of individual heads, and would, in many cases, render it profitable to put down in India whatever special plant might be necessary.

The representatives of manufacturing firms in Great Britain who have established branches in India claim that, with their local knowledge, they could in many instances supply the requirements of Government much more expeditiously and more cheaply, if supplies were obtained direct from them rather than through the Stores Department of the India Office.

No specific evidence has been forthcoming as to the extent to which Indian manufacturers are handicapped in meeting the demands of Government departments, by reason of the unfavourable position in which they are usually placed, when competing with tenders received by the India Office Stores Department in London. But of the actual fact there is no doubt. The Director-General of Stores is allowed considerable latitude in regard to the time he takes to furnish supplies. He is thus able to combine indents received from all parts of India and to purchase in bulk, whilst the Indian manufacturer is usually called upon unexpectedly to supply small quantities at comparatively short notice.

Lack of local inspecting agency.

193. The local purchase of stores entails upon the officer making it the responsibility of ascertaining by inspection that the goods supplied are of the requisite quality, while by sending the indents to the India Office Stores Department, he is relieved of any trouble on this account. Frequently he knows little or nothing about the manufacture of the articles which he has to

purchase; he has scanty means of ascertaining their market value; and he is unable easily to obtain expert and disinterested advice on such matters. With the exception of the Railway Board and the Ordnance Department, no department of Government, it is believed, was provided before the war with an efficient organisation for the inspection of local purchases, still less of local manufactures; and without such an organisation it is obvious that Government officers could not safely enter into large local contracts.

Change required in system of purchase.

194. It appears to us that, in the interests of Indian industries, a radical change should be made in the methods of purchasing in India Government and railway stores. The existing system has been handed down from a time when India was almost entirely dependent upon Europe for manufactured goods; but it is unsuited to modern conditions and has had a deterrent effect on attempts to develope new industries in India. As we have already said, we consider that the prescriptions of the Stores Rules regarding the classes of articles that may be bought in India are suitable, subject to the addition of a provision which, we understand, is now under consideration, regarding purchases from Indian branches of British manufacturing firms. The organisation which we are proposing will ensure that the fullest use is made of these prescriptions, in view of the progress which has been made, and will be made in the future, in Indian manufactures. Further experience of the working of an Indian Stores Department may, however, indicate the desirability of modifications.

Relative advantages of local and centralised systems of purchase.

195. The possibility of the local purchase of stores produced in India, but hitherto obtained in England, depends primarily on the existence of an expert agency in India, which will ensure that the stores obtained are of suitable quality and price, and we think that the same system should be applied to a large proportion of the articles already purchased in this country. Great economies have already been effected by the Munitions Board through the centralised purchase of local manufactures, especially in the case of textiles; and it is a question for consideration how far the advantages of this system warrant its general adoption. The present system of local purchase by individual officers is in any case wasteful, and requires considerable modifications. Assuming the necessity of some form of centralisation, we have also to consider the advantages of provincial *versus* imperial buying and inspection. There are instances where a single province has a monopoly, as Bengal has of jute manufactures, or Bihar and Orissa of steel. There are some cases where the manufacturing equipment of certain provinces is vastly greater than that of others, whose demands are almost equally great. There are other cases where the provincial equipment is more nearly proportionate to provincial needs. Some provinces have local manufactures of tools or machinery, which it is desirable to encourage. If a purely provincial purchase organisation were adopted without any safeguards, provincial departments would be competing against each other with comparatively small orders to fill, and against the imperial organisation with much larger ones, thereby losing all the advantages of large-scale purchase and possible standardisation. On the other hand, the further distant he is from the manufacturer who supplies him, the less are the advantages of purchase in India to the indenting officer; and it is desirable, within reasonable limits and with due regard to economy, to encourage the industries of a province by the local purchase of provincial requirements. In some cases, the middle course might be adopted of arranging for running contracts by a central agency with local producers for local supply. Manufacturers in Calcutta, Bombay, or Madras, under this arrangement, would quote rates for the delivery of certain classes of goods in certain areas, fixed by agreement with the Controller-General of

Stores, and local officers would fill their requirements from these. Such rates might be on a sliding or a fixed basis, according to the class of article. In any case, some means of mutual adjustment and of exchanging information regarding local prices and qualities is obviously needed. Moreover, if efficiency, whether in purchase or in inspection, is to be maintained, a certain minimum staff is required, and this staff will not vary greatly, whether the purchases made be few or many. If it be unduly reduced, adequate expert knowledge will no longer be forthcoming, and Local Governments will be accordingly exposed to the risk of being overcharged and of receiving inferior material.

Appointment of expert committee proposed.

196. No decision can be reached regarding the precise organisation which should be employed, or the degree of centralisation which it is desirable to adopt, until the whole question has been examined in detail by a small expert committee, with special reference to each of the leading classes of articles purchased, the extent to which they are produced in the different provinces, and the facilities with which local Departments of Industries can suitably be equipped for inspection and purchase. For the purposes of our financial estimate only, we have found it necessary to assume a system of completely centralised purchase and inspection; but we feel sure that the proposed committee will be able to effect a considerable degree of decentralisation at the outset, and will provide for still further devolution, as the organisation developes and a settled policy becomes established.

Nature of future organisation.

197. Without anticipating the committee's conclusions as to how individual classes of stores should be treated, our own consideration of the question leads us to the view that the general nature of the future organisation should be on the following lines. There should be an imperial Department of Stores and provincial agencies which should form part of the provincial Departments of Industries. This would set free individual officers from the responsibility for the local purchase of most classes of stores, and provide for expert purchase and inspection. The imperial Department of Stores should have at its head a Controller-General of Stores, with his headquarters at Calcutta; it would purchase and inspect stores, and deal with indents received from provincial Directors of Industries. In each provincial Department of Industries, there should be a stores branch, for the control of which, in the major provinces at any rate, an experienced officer would be required, who should be responsible for local purchases, and should utilise the staff of the department, as far as possible, for inspecting and testing the goods supplied through him.

All indents for stores required by provincial officers should come to the Director of Industries in the first instance. He would examine them and arrange for the local purchase and inspection of those items which could suitably be dealt with in this way. The Director of Industries would receive information, as explained below, from the Controller-General of Stores, which would enable him to form an opinion as to the possibility of obtaining more favourable tenders for such articles from another province, and it might be considered advisable in such cases for him to arrange for purchase and inspection through the local Director of such province. The balance of the indents would be forwarded to the Controller-General of Stores, who would again examine them and issue orders for the purchase of the remaining items which in his opinion could be advantageously obtained in India. He would, as we have already indicated, in some cases enter into running contracts, in pursuance of which Directors of Industries would be able to purchase from contracting firms without further reference to him. In certain cases it would be best for him to effect purchases himself, whether under running contracts or as isolated transactions, where the articles could not conveniently be dealt with by provincial agency. Experience of local and imperial sources of supply would soon show what are the respective capacities of these for meeting orders; and, in practice, no delay would be involved in deciding what items would have to be obtained through the buying agency in England, which must, for some time to come, continue to be the Stores Department of the India Office. All railway indents, which are at present sent to the Stores Department of the India Office, would be passed through the Controller-General of Stores, who would deal with them in the same way as with other indents. Orders on the firms of any province, whether from another provincial Department of Industries or from the Controller-General of Stores, would ordinarily go through the local Director of Industries, though, where centralised purchase is necessary, it would be in some cases desirable for the Controller-General of Stores to deal with local firms direct. Under this system the manufacturers of each province would be given the opportunity of supplying their own Local Governments, so far as they were able to do so, as well as those of other provinces in which similar manufactures have not been established. With the Controller-General of Stores would rest the responsibility of deciding whether indents are to be transmitted to London or local manufacture undertaken. Only in the case of heavy machinery and constructional iron work is there likely to be any difficulty in coming to a decision. In these cases much depends on the designs and specifications, and very highly specialised experience is required to ensure satisfactory results. This has hitherto been obtained in London through the agency of the consulting engineers employed by the India Office, and a similar technical agency will have to be created in India, if full advantage is to be taken of the increasing capacity of the country to turn out heavy work. The annual report of the Controller-General should include a classified statement of the articles obtained in India and abroad and the prices paid.

Importance of an efficient inspecting staff.

198. Inspection of local purchases would be carried out by the staffs of the local Departments of Industries, where they include suitable experts. But the range of Government requirements is so wide and involves the expenditure of such large sums, that the experts required for the assistance of provincial industries will be quite inadequate to inspect all the articles purchased locally: moreover, to require them to do so would in some cases cause delay and interfere with their ordinary work. The urgent necessity of securing economy and efficiency in the expenditure of the vast sums of money spent on the purchase of Government stores requires a very efficient and reliable staff of imperial inspectors, including a varied range of specialists, and we wish to point out that, though this staff may appear at first to be expensive, the cost of its maintenance will be small compared with the risks involved in purchasing stores without expert check. The activities of these officers would form one of the most valuable sources of industrial intelligence, and if, therefore, they are organised by an enlightened departmental head and are exchanged from time to time with officers employed under Local Governments in the encouragement of local industries, there is no doubt that the entertainment of this staff will be a real economy, both directly in the saving of money on purchases, and indirectly in the development of new industries. We contemplate that an arrangement will grow up of a kind that would prevent undue interference with the provincial Directors in the purchase of local products, and that consequently, while the right to inspect may exist, it will be exercised with judicious discretion and not in officious detail.

There is always a natural reluctance on the part of local purchasing officers to undertake the responsibility for quality. This feeling has, in fact, been one of the reasons why they have indented on the Stores Department instead of obtaining their requirements in India. We feel sure, therefore, that provincial purchasing officers will welcome the intervention of an imperial inspecting staff.

As we have stated above, we consider that one great advantage of the inspecting staff would be the transmission of information from one province to another regarding sources of production and improvements in manufacture, thus enabling each province to learn by the experience of others and facilitating more uniform progress in all parts of India. We propose that the Controller-General of Stores should work in close contact with the Director of Commercial and Industrial Intelligence. The arrangements for securing this object will be explained in Chapter XXII.

CHAPTER XIII.

LAND ACQUISITION IN RELATION TO INDUSTRIES.

Difficulties of industrial concerns in acquiring land.

199. Many witnesses, representing both large and small interests, complained of the handicap imposed on industrial enterprise by difficulties in obtaining land for the sites of factories and other industrial concerns, and the surface rights of mines, in cases where mineral rights are not the property of Government. These difficulties are said to lie, first, in the trouble experienced in obtaining a good title, in view of the complicated system under which land is held in certain parts of the country, especially in Bengal, and in the absence in some provinces of an authentic record of rights; second, in provincial laws, designed to prevent the expropriation of tenant interests; and last, in the attitude of landowners, who are too apt to exploit unduly the necessities of an industrialist whose choice of the site for a new venture is limited by considerations of transport, water supply, etc., while he is still more fettered when he desires to extend an existing factory. There are also often cases where the land required belongs to a large number of small owners, and when any one of these declines to sell, his refusal may render the consent of the rest useless. We have also received complaints regarding the obstinate and dilatory attitude often taken up by landowners in negotiating transfers. Although the indefinite subdivision of titles in some parts of India renders these difficulties somewhat more acute, they are not, we recognise, by any means peculiar to this country.

Cases where a willing transferor is prevented by law from passing a clear title.

200. Before discussing the question of State expropriation of private property, we will deal with those cases in which a willing transferor is prevented by law from passing a clear title. The mechanism for meeting this difficulty will doubtless vary in different provinces. In the Punjab a transfer to a trader of land belonging to an agricultural tribe cannot be made without the special sanction of an executive officer; and a wide range of relatives and collaterals possess the right of pre-emption. Moreover, the reversioners of a transferor have, by Punjab customary law, the right to sue to set aside a transfer made without necessity. But in this province pre-emption rights have been already declared non-existent in certain areas adjoining large towns. In the Central Provinces means are being sought for enabling, under suitable conditions, a transfer of occupancy and ordinary holdings to be made, when the land is required for non-agricultural purposes. Generally speaking, we consider that, although laws have been made to prevent certain classes of persons from being deprived of their rights in land, even by their own voluntary action, because the cultivation of that land by, or under the control of, other classes brings about an undesirable state of affairs, there is no reason why the same measures should be required for land which would not remain agricultural land after transfer. We have no hesitation, therefore, in recommending that provision should be made in local laws, where necessary, to enable tenants, who are prevented by legal restrictions from transferring their land or from conferring an absolute title therein, to do so with the sanction of some proper authority, when it is required for an industrial enterprise, more particularly for the housing of industrial labour; and this without depriving the proprietor of his existing rights of profit on such transfers.

We also recommend that Government, as an owner of land, should set an example to private proprietors of a liberal policy both in respect of its rules and of their practical application, in permitting transfers of land for industrial purposes.

Proposal for compulsory declaration of rights objectionable.

201. We are unable, however, to support a proposal which was put before us, to allow an industrial concern desirous of acquiring land to call on all persons affected to put in their declarations of all titles or interests in the land within a certain time, any subsequent claims being barred. This proposal would, we think, inflict hardship on ignorant title holders, *pardahnashin* women and absentees, who are often themselves unaware of the precise extent of their rights.

Acquisition by Government on behalf of an industrial concern under section 40 of Land Acquisition Act.

202. The main question which was pressed on our attention was the desirability of a more uniform interpretation of the expression in section 40 (1) (*b*) of the Land Acquisition Act, which refers to the acquisition of land for a Company, that a work " is likely to prove useful to the public. " The interpretation put on the wording of section 40, as indicated by the purposes for which this part of the Act has been used from time to time, seems to show some uncertainty as to the class of case to which it should be allowed to apply. There appears to be some division of opinion among legal authorities as to the circumstances in which the Land Acquisition Act can be fairly used by a Local Government on behalf of an ordinary industrial company. We are not sure, therefore, whether the Act needs revision to cover the recommendation which we make below.

The matter was carefully considered by the Bombay Advisory Committee, who suggested the following formula as a guide to Local Governments in the exercise of their discretion as to acquisition on behalf of an industrial concern:—" When . . . such acquisition is indispensable to the development of the industry, and . . . the development of the industry itself is in the interests of the general public." From this proposal there was found, on discussion with the committee, to be at least one dissentient, who was inclined to hold that any such proposal for compulsory acquisition should be submitted to the Provincial Legislative Council, or at least to a specially constituted committee thereof. The idea of procedure by private bill in such cases was also discussed. These suggestions relate rather to the mechanism through which the Local Government should exercise its discretion, than to the principles which should guide it in forming its opinion, and we therefore think it unnecessary to consider them in detail here. We would recommend that the formula proposed by the Bombay Advisory Committee should be adopted with the following modifications :—

The Local Government may acquire land compulsorily from private owners on behalf of an industrial concern, when it is satisfied—

(1) that the industry itself will, on reaching a certain stage of development, be in the interest of the general public ;

(2) that there are no reasonable prospects of the industry reaching such a stage of development without the acquisition proposed ;

(3) that the proposed acquisition entails as little inconvenience to private rights as is possible, consistently with meeting the needs of the industry. In this connection we wish to draw particular attention to the desirability of avoiding, as far as possible, the acquisition of areas largely covered by residential buildings.

We also propose that, on the recommendation of local bodies, Government may compulsorily acquire land to provide fresh sites for industries, which it is necessary to remove on sanitary grounds, and for industrial dwellings. Further, when Government considers an industrial undertaking deserving of substantial assistance in other ways at the public expense, especially when it adopts such a course as an alternative to carrying on the industry itself, there seems no reason why land, when necessary, should not be acquired compulsorily.

It should be a *sine qua non* that, in all cases where land is acquired compulsorily for industrial enterprises, arrangements should be made to offer cultivators or house-owners so dispossessed suitable land in exchange or part exchange. Such a course will mitigate more than any mere money payment the hardship and sense of unfair treatment caused by expropriation.

CHAPTER XIV.

TECHNICAL ASSISTANCE TO INDUSTRIES BY GOVERNMENT.

Reasons for adopting in India a policy of direct assistance to industrialists.

203. It is necessary to indicate in somewhat greater detail the special necessity which exists in India for direct Government participation in the initiation and improvement of industries by experiment, by advice and help, and where necessary, by example. We think that in the peculiar circumstances existing in this country, any limitation of the functions of the State in accordance with the principles laid down by Lord Morley, which we have quoted in Chapter VIII, will render our proposals of little benefit to Indians and will also detract largely from their general usefulness.

The risks to which private enterprise is exposed in India or elsewhere, when embarking on industrial work in new directions, are proverbial. India, however, possesses one great advantage; the new industries or processes that may be started here are almost always old industries or processes in other countries, though they may require modifications to suit them to Indian conditions. On the other hand, the country's lack of industrial organisation, of private consultants and specialists, of information on the industrial value of raw materials, and of experience in the way of approaching industrial problems, are serious obstacles, especially to the smaller-scale undertakings. Under present Indian conditions, this class of organised industries has great possibilities and is in every way well suited to Indian enterprises in most parts of the country. But the Indian investor is most reluctant to risk his money in undertakings of this sort, unless they relate to industries which are already established and practised extensively. Of the readiness to invest money in industries which can already claim a number of successes, we have had abundant evidence; indeed this tendency has had the unfortunate effect, in some instances, of creating more individual undertakings than the industry can support. This seems, at any rate, to indicate that there is capital seeking industrial outlets, and that the directions in which it can be employed are at present, from the point of view of the Indian investor, insufficient. We are further confirmed in this view by the freedom with which money is forthcoming for new ventures where the management has earned public confidence.

Difficulties experienced by Indian industrialists.

204. If we are to suggest the way in which Government assistance can best be given, it is important for us to understand the difficulties of industrialists who engage in new undertakings in India, especially on a small scale. The smaller industrialist, whether Indian or European, who is thinking of taking up a new venture, seldom has the advantage of a name which commands the confidence of a wide section of investors, or the support of large resources of his own, and he is thus not in a position to engage the assistance of experienced technical advisers in his preliminary investigations. The knowledge of the industry which he possesses is more often than not incomplete. He may have familiarised himself with it in actual operation in another country; but to start it in a new field demands greater practical experience and skill than he has usually acquired.

But even in the case of the larger undertakings, where funds are sufficient to engage expert technical advice, the following difficulties often occur:—

(1) There is frequently some uncertainty as to the quality and quantity of the raw material. At the outset, it may apparently be abun-

dant at reasonable prices; but directly any demand for it is created, the supply falls off or prices unaccountably rise. It is, therefore, difficult to frame a safe estimate beforehand on this point, simple as it may seem.

(2) The industry may involve the training of labour to carry on its operations, and this may entail a very considerable initial outlay, adding greatly to the cost.

(3) Country-made articles competing with foreign imports are always looked upon with suspicion, and generally have to be sold at a much lower price to command a market, even when the quality is equally good.

(4) When success is attained, rival enterprises are immediately started, the trained labour is enticed away, the cost of the material is sometimes enhanced, and competition, possibly in a weak market, has to be faced, with the result that the monopoly upon which a new enterprise must count to recoup extraordinary initial expenditure rapidly vanishes, and profits are reduced to a level at which only those can work successfully who have benefited by the work of the pioneer without having had to pay for it.

The cautious individual realises these risks and refuses to be tempted into new paths. Those of a more sanguine temperament or with less experience are attracted and too often come to grief.

Some of the difficulties which we have enumerated above are common to new industrial efforts in all countries, and cannot be eliminated in India. But the Government organisation which we propose will at any rate ensure technical advice for the small industry, and adequate economic and scientific data for all classes of undertakings. This will furnish industrial enterprise of all kinds from the outset with much better prospects of success than in the past. We believe that public opinion is completely changed in regard to the permissible limits of State activity, and that the grant of such assistance as we propose is urgently demanded.

Meaning of "pioneering" and "demonstration."

205. We have already, in previous chapters, explained our views regarding the means of providing industrial research and the results that are likely to follow from it. We think it desirable now to explain the meaning which we attach to the terms "pioneering" and "demonstration," when applied to Government industrial undertakings started for the assistance of industries. These two expressions are often used as if they had the same meaning, and with the vague idea that they cover the whole field of Government assistance. In any case, they represent the greatest departure from the old *laissez faire* standpoint; and it is for these reasons that we consider it advisable to describe the actual methods which these terms are intended to denote, and the limitations to which these methods should be subject.

"Pioneering."

By "pioneering" we mean the inception by Government of an industry on a small commercial scale, in order to ascertain and overcome the initial difficulties, and discover if the industry can be worked at a profit. It must be clearly understood that Government should only undertake the pioneering of industries when private enterprise is not forthcoming, and that, as a general rule, Government participation should only be continued till the object with which the operations have been started has been fully attained. By this we do not mean that the Government factory should necessarily be closed down, as soon as a private individual or company is willing to take it over, or it has reached some degree of commercial success. The opportune moment can be decided only by a full review of the circumstances of the case, and in some instances it will be found that the new industry is capable of development far beyond the initial stages at which it is profitable, before the withdrawal of Government becomes imperative in the interests of those who have invested, or are anxious to invest, capital in the new industry.

"Demonstration."

Further, a Government factory which has successfully passed through the pioneer stage will often prove a useful training ground, both for the men who are to control the industry in the future and the workmen who are to be engaged in it. This leads us to consider the suggestion made by some witnesses, that Local Governments should establish and manage what may be conveniently termed "demonstration factories." The objects might be either educational, in which case these factories would serve as schools for the training of men as operatives, foremen or managers, under strictly commercial conditions; or, in other cases, the primary idea would be to show how to improve local industrial practice. As examples of the first, we may cite a glass factory, in which the training of operatives would be the *raison d'être* for its existence; of the second, a silk-reeling and throwing house to demonstrate the advantages of modern methods of operation on a factory scale, in comparison with the existing indigenous cottage methods. These factories would be the counterpart in industries of the demonstration farms established by the Agricultural Department. In actual practice they would be required principally in connection with the development of cottage industries, and we allude elsewhere to their necessity as a part of the scheme for the training of hand-loom weavers. If the object with which each factory of this class is started be kept strictly in mind, there can be no doubt that, so long as it fulfils its primary function, it must prove useful and can in no sense be regarded as likely to interfere with the development of private enterprise.

Division of industries into "cottage," "small organised" and "large organised" industries.

206. Starting with this preliminary statement of our views regarding the attitude which should be adopted by Government in rendering assistance to industries, we may now indicate the different ways in which action can be taken and the various methods by which the machinery that we have proposed to create can be brought into direct contact with industries. We have now in India two industrial systems working side by side, covering respectively:—

(*a*) Industries carried on in the homes of the workers, which we have designated as "cottage industries." In these the scale of operations is small and there is but little organisation, so that they are, as a rule, capable of supplying only local needs.

(*b*) Organised industries carried on in workshops or factories, which vary in size from simple rural factories, carrying out a single operative process, to the big textile mills and engineering workshops, employing thousands of hands and possessed of a complete organisation both for manufacture and trade.

These organised industries may be subdivided into two classes. In the case of the first, the interests involved are mainly of a provincial character. In the case of the second, the industries have markets extending far beyond the boundaries of a single province or even of India, and their inception and management give rise to questions of inter-provincial or even international trade, which can best be handled by an imperial organisation. As examples of these two classes of organised industries, we may cite, as belonging to the first, engineering workshops, tanneries, sugar factories, rice mills, some textile mills, cement works, glass works, wood distillation plants, distilleries and breweries, and the majority of the miscellaneous workshops engaged mainly in manufacturing for a local market. In the second class will be included industries usually carried out on a very large scale and involving very high capital expenditure, such as "heavy" chemical works, iron and steel works, electro-metallurgical and electro-chemical works, ordnance factories, factories for the manufacture of explosives, and the larger metalliferous mines with their associated metallurgical works.

It will, we think, be obvious from the outset, that each of these systems will require separate treatment, and the manner in which they can be assisted will be most easily explained by a reference to examples which have come to our notice.

Help to cottage industries.

207. As regards cottage industries we need add but little to our remarks in Chapter XVII. The workers are usually uneducated and without a knowledge of anything regarding their trade, except what can be acquired locally. Their lack of education denies them access even to the most elementary technical literature, and they can be influenced only by ocular demonstrations in their own neighbourhood. Had the activities of the Agricultural Department been confined to laboratory experiments or pot cultures, they would have had but little influence on the cultivators of the country. We found in Madras that the hand-loom weavers had been greatly influenced by the peripatetic weaving parties which are at work there, and useful results have been obtained in Mysore by sending round a skilled blacksmith and his assistant, provided with suitable tools, to teach the village artisans improved methods of smithery. Owing to their lack of contact with the outside world, new ideas do not readily occur to these small workers, and they can receive material help from the supply of new patterns and designs, an example of which we saw at the Amarapura Weaving School near Mandalay, where the popularity of the school was almost entirely due to the new designs introduced by the Superintendent. Much useful work can be done by bringing to the notice of artisans labour-saving devices, or even such complex pieces of mechanism as the jacquard machines for weaving intricate patterns on hand-looms. The processes employed by metal workers are especially susceptible of improvement in this way. In most parts of the country they are ignorant of the use of patterns for casting work and of the advantages of stamping, pressing and spinning metal. Where considerable colonies of these artisans exist, their status can be raised and their output greatly increased by the establishment of small auxiliary factories employing machinery to carry out operations which involve much time and labour, when carried out by hand. These may be started by private individuals, by Government, or by co-operation among the artisans themselves, assisted by Government. Some attempts in this direction, we found, had been made in Madras, Nagpur and the United Provinces; but equipment was lacking and the attempts were not properly carried through. The extent to which co-operative working can be introduced among artisans has not yet been investigated, and we have alluded to this subject in Chapter XVIII. In towns and cities where there is a public electric supply, the use of electro-motors for driving small machines has been but very slightly encouraged. We have not the least doubt that they will ultimately prove most helpful to the artisan and will greatly facilitate the introduction of a more organised system of production. Finally, we have to draw attention to the urgent necessity for introducing better methods of marketing the outturn of cottage industries. In this matter it would appear that Japan has been singularly successful, and we have gathered

evidence to show that it is only the initial difficulties connected with the organisation of such work, that have debarred India from participating in similar advantages.

Help to large organised industries.

208. In the case of the existing larger organised industries, there will seldom be any call for technical assistance, as they are under the control of competent experts, who will only look to Government to conduct scientific researches and to provide accurate economic data, including such information as it will be the duty of the Commercial and Industrial Intelligence Department to supply. In the inception of industries of this class which are new to India or to a particular area, Government can render much assistance, both by way of conducting preliminary investigations regarding the raw materials available, the conditions under which the industry may be carried on, and the markets open to its products, and by the supply of technical advice in regard to the location of the factories, the design of the buildings, the arrangements for water supply and the selection of the machinery to be employed. To carry out this work, the services of industrial experts, who would be mainly mechanical engineers with special industrial experience, would be necessary; and the imperial scientific services would be drawn upon to provide the more highly specialised forms of scientific and technical assistance. Preliminary enquiries will frequently involve the examination of raw materials by an analytical chemist, and, in each province, there would be required at least one man drawn from the Indian Chemical Service, with a staff of assistants and a properly equipped laboratory, to deal with this work and to advise on ordinary local questions such as the quality of the water supply, the calorific value of the fuels available and the disposal of refuse.

Help to small organised industries.

209. We have already emphasised the importance of small organised industrial undertakings, and have explained the difficulties which confront them and the reasons why they have so largely failed to attract support. The Indian industrialist operating on a small scale frequently embarks on a venture, being imperfectly acquainted with the nature of the business, and, at the very outset, handicaps himself by laying out his limited capital on unsuitable plant and machinery. There are no consultants to whom he can go for advice, and usually he copies blindly what he has seen working somewhere else. It is desirable to provide competent technical assistance for such a man. To furnish some idea of the scope and variety of work in this direction which a Local Government may properly undertake, we have tabulated at the end of this chapter the technical assistance which may be rendered to industries, provided the Department of Industries is equipped with a suitable staff, many of the members of which would be drawn from the imperial services which we propose.

Initiation of small industrial undertakings.

210. It is obvious from an examination of this table of industries that a considerable number of experts are necessary to advise what should be done, if each undertaking is to start under favourable conditions in respect of plant and of methods of working. It cannot be too strongly emphasised that in a country like India, where a very high return is expected on capital, every possible care should be taken over the preliminary enquiries and in the preparation of the plans, to secure the highest degree of efficiency compatible with the conditions of working. The saving of labour is not always a matter of importance, and it often happens that nothing is to be gained by the adoption of absolutely automatic plant; but, on the other hand, it is essential that the efficiency of processes of conversion or extraction should be as complete as possible, and that there should be no avoidable waste

of raw materials or accumulation of useless by-products. Many of the failures of the past have been due to neglect of these important matters.

An experienced Director of Industries would have no difficulty in deciding what type of expert is required and at what stage he should be called in. For some industries the Imperial Government should retain such men in its service, who would be deputed to assist provincial undertakings whenever necessary. Occasionally, the matter in hand may necessitate the engagement of experts to deal with particular problems; but, as has been already said, the majority of cases will simply involve the introduction into India of the most advanced practice in Europe or America. Such knowledge is usually in the possession of firms who have taken up the manufacture of the plant required, and the expert advice can be obtained by calling for tenders to comply with specified conditions. The staff of the Local Government must be in a position to prepare the specifications and be capable of determining whether the tender submitted complies therewith satisfactorily. Where considerable preliminary research is necessary, or where the raw materials have to be subjected to detailed examination, it may be anticipated that the officers attached to technological institutes will be able to render useful service, and, as these institutes develope, they may be expected to supply in India itself the class of men who will ultimately become specialists in the various branches and ramifications of technology.

Maintenance of small industrial undertakings.

211. In addition to rendering assistance in the starting of new industrial undertakings, extremely useful work can be done by Government for many years to come, in helping the owners and managers of small power plants to maintain them in good working condition. We were particularly struck with what has been done in this direction in the Madras Presidency in respect of the numerous small pumping installations, rice mills and other power plants which have been installed in recent years, chiefly by reason of the assistance given through the local Department of Industries. The necessity for this kind of assistance in a country like India, where the use of machinery is so little developed, becomes the more apparent, when we remember that even in England, the owners of steam boilers established sixty years ago, and have voluntarily maintained ever since, what is known as the Manchester Steam Users' Association, whose object is, by competent and scientific inspection of steam plants, to prevent boiler explosions. What is found so useful in England in respect of part of the equipment of a factory as to be carried on by a private association, will be found of great advantage in India in respect of the whole equipment.

Industries of national importance.

212. In our chapter on the industrial deficiencies of India, we have given some account of the work which will have to be done to place India on a firm basis of economic self-sufficiency and of self-defence; and it is clear that, from this point of view, there are strong arguments for a policy of direct Government assistance in respect of essential new industries. We contemplate that only in exceptional circumstances will Government itself carry on industrial operations on a commercial scale; but it is necessary to establish and maintain Government factories for the manufacture of lethal munitions, and to exercise some degree of control over the private factories upon which dependence will be placed for the supply of military necessities. This, in most cases, could be obtained in return for guarantees to take over a definite proportion of the output, and should be exercised only to ensure that adequate provision is made to meet the prospective demands of the country in time of war. The methods which will have to be adopted to secure the establishment of such industries would

naturally vary with the conditions under which each will have to be carried on. The degree and kind of aid which would have to be furnished, would largely depend upon the extent to which their productions can be disposed of through the ordinary channels of trade. In some instances, the conditions may be such that the expense of production will always exceed the cost at which articles of similar quality can be imported, and in such cases the industry can only be maintained by the grant of direct financial assistance or by the indirect operation of protective duties. In those industries which it is desirable to start and maintain on military grounds, the responsibility for action must lie entirely with the Imperial Government, who would naturally invite such assistance as Local Governments can usefully afford.

Besides industries essential to the safety of the country in time of war, we have mentioned others which will be of considerable economic importance and add to the industrial strength of the country in peace time. The natural resources of India are capable of furnishing the raw materials of many industries which do not now exist in the country ; but knowledge regarding them is by no means complete, and there is no fund of accumulated experience. We have already explained, when dealing with the question of assistance by Government to the large organised industries, what forms this assistance may suitably take. The actual inception of these undertakings will usually be a matter for private enterprise, and the necessary assistance can usually be afforded by the local Departments of Industries, with the help, in some instances, of imperial officers; but they will sometimes be of such importance to the country generally, and require the employment by Government of so costly and specialised an agency to work out the preliminary data, that it will be beyond the scope of any Local Government to do all that is needed. A potent means of aid in the case of industries producing articles required by Government would be guaranteed orders, and these can be arranged for on the fullest scale only by the Imperial Government.

Organisation required by Government to fulfil the above duties.

213. The foregoing description of the methods to be adopted by Government in assisting directly in industrial development will show the necessity of an extensive administrative machinery. Nearly every provincial Government has set about establishing a Department of Industries, and the bulk of the executive work will naturally fall to these departments, which should have at their heads experienced industrial experts. They will require in most of the provinces a large staff of officers with special qualifications. Those directly associated with organised industries would be men of scientific attainments, who have specialised in mechanical engineering with a view to its technological applications, whilst a staff of skilled and experienced craftsmen would be required for the assistance of cottage and minor industries. Already in Madras it has been found necessary to appoint district officers in places where industrial developments are proceeding apace, in order to provide for the efficient supervision of new undertakings, and to ensure prompt assistance to those in operation, whenever accidents occur or difficulties crop up that are beyond the capacity of the management. The volume of such duties is rapidly increasing, and may probably grow even faster under the stimulus of the measures which we propose in this report.

Functions of Imperial Government.

214. While we contemplate the utmost possible decentralisation, we have shown that some share in the direct assistance to industries by the State will have to be taken by the Imperial Government. The exact line of demarcation will, to some extent, depend upon the degree of provincial autonomy accorded to local administrations; but it is obvious that the imperial depart-

ment should exercise supervision over research work; that it should be responsible for the conduct of investigations of general interest to the greater part of India; that it should exercise control over Government factories and such industrial undertakings as are necessary in the interests of national safety, or the scope of which brings them outside the range of the equipment with which provincial Departments of Industries will ordinarily be provided, and, finally, that it should watch over provincial administrations in order to secure the maintenance of a uniform industrial policy.

Examples of industries that might be aided by provincial Departments of Industries.

Serial No.	Name of industry.	TECHNICAL HELP REQUIRED TO INITIATE.		Explanation.	In general charge of working after start.
		Scientific advisers.	Engineers and Experts.		
1	Saltpetre.	Bacteriologist, Chemist.	Engineer (*a*)	(*a*) To specialise, design and advise as to factory plant.	Chemist.
2	Glass.	Chemist, Mineralogist.	Group of glass specialists (*b*).	(*b*) *Vide* Appendix E.	Trained general glass expert.
3	Oil milling.	Chemist	Engineer (*a*) Specialist (*c*)	(*c*) Different classes of oil seeds demand special knowledge in some cases.	Chemist.
4	Matches.	...	Timber expert (*d*) Specialist (*e*)	(*d*) Imperial Forest officer. (*e*) Will advise as to selection and working of plant.	Trained expert.
5	Flour and rice milling.	...	Engineer (*a*)	...	Engineer.
6	Pumping plant.	Geologist.	Engineer (*a*)	...	Mechanic.
7	Hand weaving.	...	Weaving specialist.	...	Master weaver.
8	Tanning.	Chemist, for tanning materials.	Forest expert for materials (*d*). Experts (*f*)	(*f*) Experts for raw materials and different kinds of leather.	Tanner.
9	Leather work.	...	Experts (subordinate).	Boots; saddlery and harness; trunks and bags.	Business man.
10	Fruit and fish canning.	Agricultural or fisheries experts (*g*).	Canning specialist	(*g*) Will belong to the departments in question.	Expert.
11	Brass work. Lamp making.	...	Engineer (*a*)	...	Mechanic.
12	Pottery.	Mineralogist.	Engineer (*a*) Experts for kiln making and ceramic manufacture.	...	Ceramic expert.
13	Soap making	Chemist	Engineer	...	Chemist and Soap boiler.
14	Essential oils	Do.	Distillation expert.	...	Chemist.
15	Wood distillation.	Do.	Forest officer Engineer (*a*)	...	Do.
16	Dyeing.	Dye chemist.	...	...	Do.

CHAPTER XV.

MISCELLANEOUS POINTS OF GOVERNMENT LAW AND PRACTICE AFFECTING INDUSTRIES.

The Employment of Jail Labour.

Lack of policy.

215. In the past there has been much complaint by Chambers of Commerce and private firms about the unfair competition of jail industries, and regulations have been made to prevent their underselling private manufacturers in the open market. The question of suitable employment for prisoners in jails has never been properly examined in reference to its economic aspect, and no general policy has been framed for the guidance of jail departments. As a matter of fact, most provinces follow more or less the same lines; but apparently the work which is actually done in jails depends very largely upon the attitude of individual Jail Superintendents. Briefly, jail industries are necessary to keep prisoners employed, to recover as far as possible the cost of the upkeep of the jails by the sale of the products of their labour, and to teach them a trade by which they may earn an honest livelihood, when they are once more free men.

Nature of industries which should be adopted in jails.

216. In jail industries, only manual labour should, we consider, be allowed, and they should be so chosen that the labour put into the finished goods represents the major portion of the cost of production. The establishment of power factories inside jails and the extensive employment of machinery we regard as undesirable, and the complaints which we have received concerning the competition of the woollen mill in the Bhagalpur jail and the cotton mill in the Coimbatore jail are reasonable. We think it is desirable that the question of the employment of prisoners in jails should be considered by experts. A careful scrutiny of the requirements of Government departments would, we believe, show that jails could supply their needs to a much greater extent than has hitherto been done. There is an obvious tendency in jail administration to regard with favour the development of jail industries with a view to large receipts. The abuses to which this policy is liable might be counteracted by giving the provincial Directors of Industries and their advisory committees some voice in the matter, with power to make recommendations to the Local Government.

The trades at present carried on in jails by habitual criminals belong very largely to the type of cottage industries, with which their products frequently compete. This seems in many ways undesirable; and furthermore it is almost unknown to find a man who has learnt such an industry under jail conditions practising it on return to liberty. If the hereditary carpet weaver understood what was going on, he would protest as emphatically against jail carpet factories as Chambers of Commerce have done against power cotton weaving in jails. As a matter of fact, his protest, though silent, is effective. He renders it impossible for a released prisoner, no matter how skilled he may be as a carpet weaver, to practise his trade, and one of the presumed objects of jail administration is thereby frustrated. Cottage industries are, moreover, comparatively light and pleasant occupations, and should be, though it is doubtful if they are in all cases, reserved for weakly prisoners. The above remarks do not, of course, refer to the inmates of reformatories or Borstal jails.

The Prevention of Adulteration.

Food and Drugs.

217. We have examined with considerable care the arguments for and against legislation to prevent the adulteration of articles intended for local consumption and of produce for export. The case of foodstuffs for local consumption presents few difficulties, for public opinion is agreed that, so far as these are concerned, their adulteration should be punishable by law. In the United Provinces, an Act has been in force for some years penalising the adulteration of food and drugs, and legislation in other provinces is following similar lines. The adulteration of drugs is, however, much more difficult to deal with, and it is doubtful if legislation is likely to be very effective in this direction. The organisation for enforcing the existing Acts requires considerable strengthening; at present it exists only in certain municipal areas.

Raw produce.

218. As regards raw produce for export or local manufacture, the balance of commercial opinion is that legislation would not be likely to effect any improvement in the present state of things. There can be no doubt that the real remedy lies in the hands of the buyers. This has been clearly proved by the improvement in quality of Indian exports of wheat since the introduction of the 1907 wheat contract of the London Corn Trade Association on a basis of two per cent. admixture of other food grains, but free from dirt. This contract has, we believe, caused no trouble with sellers, and it appears to us that its provisions might be extended. Linseed and other oil seeds have also been shipped to the United Kingdom on pure basis contracts since 1913, with satisfactory results to all concerned, and a suggestion has been made that exports of oil seeds to other countries also should be similarly regulated. But we repeat that these are matters for arrangement between exporters and their buyers, and that the latter are in a position to insist upon freedom from adulteration if they really want it.

Wheat.

Oil seeds.

Jute.

In the case of jute, the question of legislation against adulteration has been frequently and thoroughly discussed within recent years, and a bill was actually drafted by the Bengal Government in 1906, but was dropped owing to the general commercial opinion, which Government appears to have shared, that in practice it would prove inoperative and unworkable. It is perhaps possible that the act of watering jute might be made a penal offence, but it would be a very difficult one to prove, as jute is naturally wet after steeping, and the matter may safely be left to the mills and the shippers, who will not buy wet jute from fear of "heart damage".

Cotton.

Similarly, it has been suggested that the actual watering of cotton might be made a penal offence, and again that the licensing of gins would probably have a deterrent effect upon adulteration. This latter proposal appears to us worth consideration, but we prefer to express no definite opinion regarding the adulteration of cotton, in view of enquiries which have been made by the expert Cotton Committee, recently appointed by Government to consider as a whole the many problems relating to this industry.

Certificates of quality.

219. An important witness in Calcutta stated to us that business in produce would be greatly facilitated, if Government certificates of quality and weight were enforced upon shippers and buyers; but when we consulted the Bengal Chamber of Commerce regarding his proposals, which they in turn referred to their membership generally, we found that the bulk of commercial opinion regarded them as wholly impracticable and unnecessary. In any case, we do not see how buyers abroad could be compelled to accept such certificates.

We consider, however, that Government should do what it can to strengthen the hands of the recognised associations which are affiliated to the various Chambers of Commerce, and should give ready consideration to any practicable proposals put forward by them, whether designed to prevent adulteration of produce or to stimulate improved production.

Fertilisers.

220. But we would make one exception to what we have written above, with reference to the trade in fertilisers. There are at present in India no laws to prevent a dealer from selling as a fertiliser anything that he may choose so to describe, nor are there any legal standards or percentages of error in description. In Great Britain, the Fertilisers and Feeding Stuffs Act of 1906 compels sellers to describe and certify their wares; it also empowers the Board of Agriculture to fix percentages of error for certain ingredients of both feeding stuffs and fertilisers. We consider that an Act on similar lines should be introduced into India, and we understand that it would be welcomed both by the trade and by the public.

The Administration of the Boiler and Prime-Mover Acts.

Diversity of practice in various provinces.

221. With reference to the administration of the various provincial Boiler and Prime-Mover Acts, there is a great diversity of practice all over India, which causes trouble to persons who purchase boilers from other parts of India or desire to employ engineers who hold certificates from other provinces. We have enquired closely into the question of the certification of engineers and boiler attendants. We do not find that in provinces where certification is required, engineers are better qualified or accidents less frequent than in those where this is not the case. It is urged that these certificates are to some extent a guarantee to owners of small industrial plants of the competence of applicants for employment. We do not attach much importance to this argument, and it will have still less weight if owners and employers have the advice of a local Department of Industries to help them. On the other hand, it is undoubtedly the case that the possession of a certificate gives a factitious value to its holder, and makes it more expensive to employ him on small installations. It is true that certain educational institutions owe many of their pupils to the fact that they prepare them for boiler certificate examinations, but this is beside the point. The demand for qualified engineers is greatly on the increase, and a better class of man than the mere 'engine driver' must be provided for the larger organised industries.

Accidents are usually due either to carelessness, or to defects in the plant. When due to ignorance, which is seldom, they are likely to occur during the absence of the responsible attendant, a possibility that is at least as great in provinces which insist on certificates as in those which do not. It must also be remembered that at present the law does not apply to the case of internal combustion engines, which are not less liable to accidents in their way than steam engines.

Recommendations of the Commission.

222. The Boiler Inspection Department is considered at length in the report of the Public Services Commission (page 126.) The Commissioners lay down four principles for general guidance :—

"In the first place, the time has come to make the boiler inspectors Government servants in every respect, like the factory inspectors, and to pay from general revenues both their salaries and their pensions, irrespective of the amount of fees earned. Secondly, expert supervision of the inspecting staff is essential. Police officers and members of the Indian civil service do not possess the necessary technical qualifications. Thirdly, the present system, by which in certain places representatives of the interests to be inspected have a voice in the management of the inspection department, is unsound, and should be abolished. Fourthly and finally, there should be one officer in each of the larger provinces who should be responsible for the effective working of the inspection staff. He should be called either a chief or first inspector according as the work to be done is on a large or small scale."

We endorse these recommendations, and would add the following :—

(1) Boiler inspection should be a duty of the provincial Departments of Industries.

(2) The Imperial Department of fndustries should draw up a series of technical rules for the guidance of inspectors in determining the pressure for which a boiler may be licensed throughout India, and should bring and maintain these rules up to date in a form applicable to the various modern types of boilers.

(3) The laws compelling persons in charge of boilers to possess certificates should be abolished.

The second and third of these proposals would involve legislation.

The Mining Rules.

Criticisms of existing rules.

223. A considerable amount of evidence was forthcoming regarding the suitability of the rules under which mining concessions are at present granted by Government. Our conclusions are that the rules have, except in a few comparatively minor respects, stood the test of working admirably and that the criticisms received were mostly shown, on discussion with witnesses, to be due to misunderstanding of the effect of the existing rules, or to failure to realise the difficulties which would arise from adoption of the alternatives suggested.

There are, however, certain matters connected with the working of the rules on which we desire to put forward our suggestions. We recorded a considerable amount of evidence regarding the injury to the mineral possibilities of the country caused by wasteful methods of working; and it was suggested that small mine owners would be greatly benefited by the advice of Government mining engineers. Some witnesses even considered that these officers should have power to compel mine owners to follow their advice. The main objection to this course is the danger of loss to a manager forced to follow official advice regarding the development of his mine. In some countries, royalty owners are interested in seeing that their properties are economically worked. In India, unfortunately, private royalty owners do nothing of the kind; indeed, in some cases they insert conditions in their leases which directly tend to cause wasteful working. Whether or not any general steps should be taken at this stage to ensure the economical working of privately owned minerals, it certainly behoves Government to secure this end in the case of its own properties. We have also considered the proposal that Government should insist on concession holders employing qualified mining engineers; but, while we recognise that there is much to be said for such a course, we feel that hardship would be caused to poor concessionaires, unless provision was made for exempting small or easily worked deposits.

Increased staff to inspect Government concessions recommended.

224. We would, therefore, only recommend at present that a suitable staff be entertained in connection with the Geological Survey Department to inspect Government concessions. The experience gained in a few years by such a staff would show how far it would be possible to insist on all Government concessions being worked by qualified men, and the extent to which small concessionaires may be benefited by the advice of Government mining engineers.

The existence of such an inspecting staff would admit of more elasticity in the terms of prospecting licenses, alike in respect of area, length of currency and rental. If Government were in a position to satisfy itself by expert inspection, that a proper amount of development work was being done, it might, in the case of a property requiring heavy expenditure in its initial stages, grant a more extensive area on a prospecting license for a comparatively long period. It would be unnecessary to burden the enterprise with a high acreage payment, when the Government inspecting staff could ensure that a proper amount of development work was being done. This proposal would, we think, meet the difficulty at present experienced by concessionaires where extensive operations for the proving of mineral values are required, as for example, boring for oil or for minerals occurring at uncertain intervals on a known geological horizon. The Mining Rules provide for the renewal of prospecting licenses under the authority of the Collector up to a period of three years. The rules are silent as to the power to give further renewals, which is presumably reserved for the Government of India. We think that, with the help of the system of inspection which we have proposed Local Governments might be authorised to grant extensions in such cases up to a maximum period of five years.

It will be noticed that this system of inspection would entail a substantial increase in the staff of the Geological Survey. Several witnesses of undoubted authority drew our attention to its inadequacy, and they hesitated to make proposals for useful forms of Government assistance to the mineral industry, only because they assumed that the cadre was fixed. In view of the national importance of minerals and of the fact that inefficient working destroys for ever the value of a deposit that might in future be of vital importance, we consider that the additional expense incurred in such an increase would be an investment that Government can undertake with absolute confidence.

Simplification of mining leases proposed.

225. In view of the constant changes in mining methods and development, we think that the present form of mining lease might be considerably shortened and simplified, leaving certain matters specified in the lease to be dealt with by rules made from time to time; such rules might be suggested by, and should in any case be submitted for criticism in advance to, local committees of private mine owners presided over by a Government official. The present system of trying to provide for every possible contingency by an elaborate lease must result in undesirable rigidity, while not securing for Government the degree of control desirable. Further than this, concessionaires, in the case of small alluvial and other obviously short-lived deposits, would probably be glad to accept short-term mining leases on simple conditions and free of multifarious restrictions.

Difficulties in acquiring mineral rights.

226. There were many complaints of the difficulties experienced by mineral prospectors or mine owners in areas where the mineral rights were in the hands of private landowners; these mainly had reference to the great subdivision of proprietorship or to the obscurity of titles. These difficulties are similar to those experienced by all investors who desire to acquire property in such areas, and we see no reason for making any recommendation regarding the registration of titles, or the compulsory acquisition of surface rights where Government does not own the minerals, except in the possible case of a mineral which is essential for national purposes, and of which only a very limited quantity exists.

Mining Manuals might be prepared in certain provinces.

227. Other complaints by witnesses had reference to local rules governing the working of special minerals, and the grant of licenses and leases of minerals outside the scope of the Mining Rules. Would-be concessionaires said that they experienced difficulty owing to the diversity of rules and practice as between one province and another, especially in respect of minerals like limestone, which are now required for large organised industries, such as iron smelting; and generally from the lack of any complete and readily accessible compendium of the local rules. We think that, in provinces where there is considerable mining activity, it is advisable for Local Governments to issue Mining Manuals similar to those published in the Central Provinces and Burma. These should include the Government of India Mining Rules, the local supplementary regulations, and any other provisions of rule or law that are likely to be encountered in the course of their work by persons engaged in mining. We suggest that these manuals would be of increased value if they contained notes prepared by the Geological Survey Department on the known mineral resources of the province and references to publications containing more detailed information.

We received also a quantity of evidence regarding certain local difficulties which have arisen in special cases, *e.g.*, in the case of mica mining in Bihar and Orissa. These involve no change in the Mining Rules, and will doubtless be considered by the Local Governments concerned.

The Administration of the Electricity Act.

Administration of law and rules.

228. A matter of considerable importance which may be conveniently discussed here, is the working of the Indian Electricity Act regulating the supply and use of electrical energy. There are now numbers of electric supply companies which provide electrical energy for domestic consumption, for industrial purposes and for public use. Although only one or two witnesses came before us whose position entitled them to give evidence on these matters, we were furnished with both information and criticisms by the representatives of the Electric Supply and Traction Federation of India. Considering the magnitude of the interests involved and the novelty of public electric supply, there was comparatively little complaint regarding the administration of the rules framed under the Act. It was, however, brought to our notice that in some provinces the professional qualifications and experience of the Electric Inspectors did not command the confidence of the managers of the larger local undertakings. The principal criticisms were that the rules were too rigidly worked, that they were sometimes wrongly interpreted, and that there was an unwillingness on the part of the Inspectors to assume the responsibility of relaxing the rules in cases which obviously demanded it. To remedy matters, it was suggested to us that men of higher professional status and with practical and commercial experience of electric supply undertakings should be appointed as Inspectors, and that an imperial Advisory Board should be established to advise Local Governments with regard to appeals from the decisions of their Electric Inspectors. We support the former suggestion strongly, but it appears to us that the appointment of provincial Advisory Boards, as contemplated in section 35 of the Act, will meet the needs of the case, especially if these Boards are permitted, when necessary, to consult experts such as the Electrical Adviser to the Government of India. We consider it extremely desirable that Government should encourage the industrial use of electricity supplied from central generating stations. It was represented to us that section 23 of the Act did not allow a licensee under the Act to discriminate in respect of his charges between the domestic and the industrial

uses of electrical energy. We are not sure if this interpretation is correct, but if so, the section would seem to require amendment. Without entering into technical details, we may state that we agree with the contention that the load factor should be taken into account in fixing the charges. In congested cities, and particularly in Calcutta where the smoke nuisance is greatly aggravated by the numerous small steam plants set up to drive rice and oil mills, it is essential that no obstacles should be created to the introduction of electrical power for industries. It appears to us that the economies which can be effected by the use of energy from public electric supplies, when reasonable rates are charged, are not yet sufficiently appreciated.

Electric Inspectors should be transferred to the Department of Industries.

229. The Electric Inspectors are attached to the Public Works Department, an arrangement probably made at the outset because that department is concerned with engineering; but, as the interests to be safeguarded are mainly industrial and commercial, we think it would be more convenient to transfer them to the Departments of Industries. So far as the technical aspect of the administration of the Act is concerned, these departments are also likely to be better equipped to deal with it. The transfer of the administration of the Act to the Department of Industries would render desirable an amendment of section 53 (1) (*a*) of the Act.

Patents.

230. India is not a member of the International Convention, and in this respect stands in a different position from most of the British dominions. The subject was discussed at the time of the passing of the Patent Act of 1911, but the refusal of India to register trade marks precluded her from joining the Convention. Any person who has applied for a patent in a country which is a member of the International Convention is entitled to protection in priority to other applicants in all other States of the Union, if he applies within one year from the date of his first application. An Indian inventor secures no such protection. On the other hand, a foreign inventor desiring to obtain protection in India must apply for a patent in India before publication in India, and is protected from the date of his application in India. Some witnesses have represented that Indian inventors are at a disadvantage on this account, but, though this possibly may be true in rare instances, the country generally is not. The number of patents applied for in respect of inventions originating in India is very small compared with that in respect of foreign inventions, and a much larger proportion of the patents granted in this country to local inventors are allowed to lapse as being of no value.

From 1893 to 1915 inclusive, the annual average number of applications for patents in India was—

From Indians	53
From other residents in India	135
From foreigners	360
Total	548

It would, therefore, appear that it is more to the advantage of India to avoid the acquisition of rights in India by foreign inventors than for Indian or Anglo-Indian inventors to obtain such rights elsewhere. Undoubtedly the majority of Indian patents are acquired for the purpose of preventing unlicensed import into India of articles patented abroad. The grant of such patents is obviously in many respects to the advantage of India, and the interest of the user and of the intending manufacturer in India are sufficiently protected if the law adequately provides for compulsory licenses or revocation in cases where the reasonable requirements of the public are not satisfied or where the patent is worked outside British India. The provisions of the existing Act in these respects appear to be sufficient, and the Indian patent law seems to be well suited to the needs of the country.

On the other hand, there is a growing body of opinion that it is desirable to consolidate the patent law throughout the British Empire, and, if this developes further, it will be a question whether India would not derive greater advantage from uniformity with other British dominions than she enjoys in her present somewhat isolated position. The number of applications shown in the records of the Indian Patent Office is still small, the totals in 1912 and 1913 being 678 and 705, respectively, of which 508 were of foreign origin in each year. The fees for the grant and renewal of patents are much less than in the United Kingdom. Thus in India, the initial fee is Rs. 40, in the United Kingdom £5; and the total cost of protection for 14 years in India is Rs. 790, and in the United Kingdom £100.

Registration of Trade Marks.

231. The subject of the registration of trade marks was brought before us once or twice, but was never strongly pressed. On the not infrequent occasions when the subject has been discussed departmentally and by Chambers of Commerce, it has been generally considered that registration of trade marks, as it exists in the United Kingdom and in many other countries, is not desirable in India, though the Burma Chamber of Commerce put forward the opinion that legislation is necessary.

We have given very careful consideration to the arguments used, and agree with the majority of the Chambers of Commerce in considering that the establishment of a system of registration would seriously disturb existing rights of user both between firms in India and, if full advantage of the proposal is to be obtained, between firms in India and firms abroad. The difficulties so created would be far greater in our opinion than the slight inconveniences experienced by owners of marks in maintaining their rights thereto.

Registration of Partnerships.

Obstacles in the way of legislation.

232. The vexed question whether registration of partnerships should be made compulsory has been many times under the consideration of the Government of India within the past 50 years. The last occasion was in 1908, when the Bengal and Bombay Chambers of Commerce both prepared draft bills dealing with the subject; but their drafts were irreconcilable, and Government considered that the proposals did not afford a basis for legislation.

During our tour we recorded the opinions of many witnesses on the subject; most of them favoured compulsory registration, should it prove to be practicable, but some, especially amongst our Indian witnesses, feared that the prevalence in Indian businesses of the Hindu joint family system would be found an insuperable obstacle. Mr. B. L. Mitter, a leading barrister of the Calcutta High Court, has made some valuable suggestions* which, we think, should go some way to remove this difficulty; these he developed further when he appeared before us to give oral evidence in support of his written statement, and he also gave us to understand that the leaders of the Calcutta Bar generally were in substantial agreement with his views. Mr. Mitter's proposals practically treat a Hindu joint family as a single partner, and provide for the compulsory registration of all contractual partnerships. So long as the business is a purely joint family business, with no stranger in it, registration would not be necessary, but directly a stranger is introduced into the business, the partnership would become contractual, the contracting parties being the joint family as a unit on the one side, and the stranger on the other. Registration would then become necessary, and the joint family would be registered in the name of the *karta* or head of it, whose declaration would bind all the family. Mr. Mitter considers that registration should be made compulsory in the case of future partnerships only, and would leave to existing concerns the option of registering or not as they may desire, his argument being that, as all partnerships have to be renewed when the terms are changed, or a partner dies, compulsory registration would become universal within a generation.

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*Minutes of Evidence, Vol. V.

The other chief obstacles in the past to the introduction of compulsory registration have been, first, the difficulty of excluding, and the hardship of including, small partnerships, of which there must be many thousands among petty shop-keepers and traders in all parts of the country; and, second, the difficulty of applying registration to transitory or single-venture partnerships, which are said to be common on the Bombay side. We see no reason why either small or single-venture partnerships should be exempted from the provisions of any legislation that may be found practicable; for to the former the analogy of custom in petty transactions in land would apply, and, as Mr. Mitter points out, these are habitually registered without any trouble and at a very trifling cost; and the latter should be, and are, governed by the law which regulates partnerships. To meet in part these suggested difficulties, it has been proposed that a compulsory Registration Act, if introduced, should run at first in the Presidency towns only; but we see no need for this restriction.

Recommendations of the Commission.

233. Looking at the matter in its purely business aspect, it appears to us that throughout the main stumbling-block in the way of compulsory registration has been the Hindu joint family system, and that the difficulties in this regard would to a great extent disappear, if Mr. Mitter's proposals were adopted; they have at any rate the two great advantages that a joint family can be registered as a single entity, and that it would be difficult for a person to deceive third parties by pretending that he was a partner, when in fact he was not or *vice versâ*. We, therefore, consider that Government should take an early opportunity of examining the whole question thoroughly with a view to legislation, and in so doing should invoke the assistance of the leading non-official lawyers in the chief business centres; for we believe that few among minor measures would do more to develope confidence and promote business relationship between Indian firms and their constituents abroad, and especially between European and Indian firms in this country.

We do not consider any system of optional registration in the least likely to achieve the desired results.

Registration of Business Names.

234. It has been urged upon us in some quarters, especially by Trades Associations, whose members have probably suffered most from the absence of it, that we should recommend legislation on the same lines as that recently enacted in the United Kingdom under war conditions, to enforce the registration of business names. This is, however, a question on which comparatively little evidence has been forthcoming, and we do not, therefore, feel justified in making any recommendation.

CHAPTER XVI.

THE WELFARE OF FACTORY LABOUR.

Nature of problem.

235. Indian labour in organised industries is much less efficient than the corresponding classes of labour in western countries; and there is evidence to show that in many cases it does not produce as cheaply as western labour in spite of its lower wages. It is true that inferior physique and tropical conditions contribute to this state of affairs; but there is grave reason to believe that the former is to some extent the result of preventible disease, whilst other causes, which are even more obviously remediable, are factors that unnecessarily increase the difficulties of our labour problem.

All authorities who are qualified to speak on the subject agree that Indian labour is content with a very low standard of comfort. This secured, the Indian workman, speaking generally, takes advantage of the greater earning power given to him by increased wages to do less work, and shows no desire to earn more money by working more regularly or by improving his own efficiency. In the case of Bombay, witnesses have stated that since the ten per cent. rise in the wages of mill operatives given during the rains of 1917, there has been an actual falling off in output.

236. There is substantial agreement between the best-informed witnesses that the remedies for this state of affairs are a rise in the standard of comfort and an improvement in public health. These ends can be attained only by education, improved housing and a general policy of betterment, in which an organisation for the care of public health must play a prominent part. If the children of workers are provided with education under tolerable conditions of life, a new generation of workers will grow up, who will learn to regard mill work as their fixed occupation. Better housing is a most urgent necessity, especially in the large congested industrial cities. Facilities for healthy amusement, shorter hours of work (though a reduction of these may for a time decrease output), and other measures for economic betterment, such as cheap shops for the sale of articles required by the mill hands, and co-operative societies, are almost equally important. The conditions under which industrial operatives live and work in this country ought, if efficiency be aimed at, to approximate, as nearly as circumstances permit, to those of temperate climates. Continuous factory work in the tropics is, at certain seasons of the year, far more trying than similar work in northern countries. The needs of domestic sanitation in large towns are more pressing. The problem, not only on moral grounds, but also for economic reasons, must be solved with the least avoidable delay, if the existing and future industries of India are to hold their own against the ever-growing competition, which will be still fiercer after the war. No industrial edifice can be permanent, which is built on such unsound foundations as those afforded by Indian labour under its present conditions.

On the other hand, the margin which the efficiency of the Indian mill hand leaves for improvement is so great that, if the problem be successfully solved, the advantage to Indian industry should be very marked.

Education of factory children.

237. The question of the education of children employed in factories was under the consideration of the Government of India between the years

1915 and 1917. Children between the ages of 9 and 14, generally known as half-timers, are employed in mills for six hours a day, and the Bombay Government proposed, after discussion with representatives of the mill-owners, to take powers, by rules under the Factories Act, to split the shift into two three-hour periods, and to compel factory owners to provide educational facilities for children in the interval. The proposal was criticised extensively on the ground that children might be induced by their parents or by jobbers to work in the mill itself between the shifts, a practice which it would be very difficult for inspectors to prevent; and because it was doubted whether a system which involved retaining the children in the mill compound for nine hours, even if three of them were to be passed in the mill school, was in itself desirable. The Buckingham and Carnatic Mills in Madras, it may be noted, keep to the six-hours shift, and educate those of the children who choose to come to school, after the earlier and before the later shift, the whole of the children working in the mill being employed in two six-hour shifts. This voluntary system has been a success, and has attracted a large proportion of the children employed. But the labour in these mills is not recruited by contractors; there are practically no rival mills in the neighbourhood; the workers are exceptionally well controlled, and special arrangements are made for the comfort of the children. It is too much to hope that, where these conditions do not exist, the same results will be attained.

But an indirect method, such as splitting the shifts, or indeed any procedure by way of amendment of the Factories Act, seems to us illogical. The first thing to do is to introduce compulsory education in areas where this is feasible, applicable to all classes of children and not merely to those employed in factories. Any consequential amendment of the Factories Act may then be considered. We note that in December 1917 an Act was passed by the Bombay Legislative Council, empowering municipalities (other than that of Bombay) to declare the education of children between the ages of 6 and 11 years compulsory subject to certain safeguards, and to raise funds to meet the necessary expenditure. In the debate on the bill, the effect of the proposed legislation on the employment of children, especially in factories, was discussed; and the conclusion reached was embodied in section 11 of the Act. This has the result of leaving it to be decided, in the first place by the school committee and in the next by the magistrate before whom a case is brought, whether the employment of a child is of such a nature as to interfere with its efficient instruction. The working of the Act will doubtless show whether any further and more direct form of restriction on the employment of children in factories or elsewhere is desirable.

Conditions of housing industrial labour in India.

238. In considering the important question of the housing of workmen, we find widely different conditions prevailing in various parts of the country. Where factories have been established at a distance from towns, the labourers are often housed in surrounding villages in much the same way as agricultural labour. In such cases employers have often found it impossible to obtain labour without providing accommodation. The dwellings take the form of single-storey lines, consisting of single-room units, with either a verandah or, in some cases, a small enclosed courtyard. Here conditions approximate to those of ordinary village life, except that as a rule the small garden plot owned by villagers in many parts of India is absent. Such conditions are satisfactory, provided that the employers enforce a few simple rules, furnish a small sanitary staff for scavenging purposes, and supervise closely the disposal of excreta and the supply of drinking water.

The next stage of development, and consequently of congestion, is exemplified in cities such as Madras, Cawnpore, Nagpur and Ahmedabad and in a very large proportion of the industrial areas round Calcutta. Here land is far cheaper than in the cities of Calcutta and Bombay, and accommodation usually consists of single-storey huts in groups known as *bustis,* erected by persons other than the owners of the mill and rented by mill hands on fairly reasonable terms. In Rangoon and other parts of Burma seen by us, adult male labourers are accommodated free of rent in large barrack rooms, holding 10, 20 or 30 men each. In all these cases there is less comfort of the kind to which the villager is accustomed, and sanitation is more difficult and requires close supervision, whether by the mill-owner or by the local authority. Even here, the more enlightened factory owner has found it advisable to provide accommodation on an increasing scale, recognising that, though the rent which he can obtain will not pay him more than a trifling percentage on his outlay, the mill which houses its labourers best will command the pick of the labour market, especially in the case of such a fluid labour force as that on which the textile factories rely. Two of the large European factories in Cawnpore, two cotton mills in Bombay, and several jute mills near Calcutta have followed this policy. The last-mentioned are providing housing for an appreciable portion of their labour, either free or at a rate much below the economic rent. The accommodation is usually of the single-storey, or at the worst of the double-storey type, and is almost invariably in single-room units. These rooms are readily taken up by the labourers, who apparently find no objection to renting them from their employers. In Ahmedabad there is a distinct movement in the same direction. In this class of areas there are two reasons which have encouraged employers to provide accommodation for their labourers. Land is cheap relatively to its cost in the cities, and the mills have usually provided themselves in the first instance with large compounds, or, if this is not the case, no prohibitive expense is likely to be entailed in acquiring sufficient site-room. In the next place, the mills are not, as a rule, so closely grouped together that labourers accommodated in buildings belonging to one mill find it easy to go and work in another. Thus, the employer who incurs expenditure in housing his labour can be reasonably sure, in most cases, that that labour will continue to work in his mill; in Bombay this does not hold good, as will be seen later. Those employers who are sufficiently enlightened to provide housing for their workmen employ expert advice as a rule, and are ready enough to consider recent ideas in regard to the design and lay-out of industrial dwellings.

General proposals regarding housing of industrial labour.

239. Great difficulty, however, is experienced in some cases in obtaining a clear title to the land and in coming to terms with the numerous small interests held therein by various classes of individual owners and tenants. We have indicated the difficulties that exist and our proposals for meeting them in Chapter XIII but, as there indicated, we would go further in the case of land required *bonâ fide* for the housing of labour, than in that of sites for directly profit-making industrial purposes. In the former case, under certain conditions, we would support compulsory acquisition, at the expense of the employer as a general rule, provided that it is clearly proved to the satisfaction of Government that the proposed area is the most suitable that can be obtained, having regard to any interests of importance that may be affected by acquisition. Due safeguards must, of course, be provided against the conversion of the land to other uses without the consent of Government, and the buildings to be erected must be of a type approved by the local sanitary authorities. We propose also an alternative form of assistance where it is desirable to accelerate unduly slow progress in housing or to avert threatened congestion. The land might be acquired at the cost of Government or of the local authorities concerned and leased by them to the employer, either at a rate which will pay off its cost over a term of years and leave it the property of the employer, or

on ordinary long leasehold terms. The land in such cases will afford ample security for the outlay. Local authorities should also be encouraged, or, where necessary, created, to ensure the development and lay-out of growing industrial areas on suitable lines, as well as to supervise sanitation. This will greatly assist employers, who can only exercise authority in this respect over the land in their own possession and often experience serious trouble owing to the condition prevailing in adjoining areas. The outbreak of plague or cholera in an unregulated *busti* adjoining a carefully managed and laid-out settlement is a most serious menace to the settlement itself. Local authorities should also be given power to declare that certain areas may be closed to industries, either generally or of particular kinds.

Special Proposals for Bombay.

Necessity for special action in case of Bombay City.

240. We should have considered the above recommendations, together with those in Chapter XIII sufficient to meet the situation throughout India generally, assuming that the various local authorities follow the policy of improving sanitation and housing in congested quarters, and take care that adequate space is laid out, or, where necessary, acquired beforehand, for industrial areas. But in the case of Bombay the existing congestion and the difficulties in the way of betterment are unique in India, and, though many proposals have been considered for dealing with them, no really practical steps have so far been taken, and special measures are obviously needed. We propose to deal at some length with the position in this city, both for the above reasons, and because Bombay is only, after all, an example of what continued neglect may produce elsewhere, though perhaps not on such an aggravated scale. Difficulties of a similar nature are beginning to make their appearance in other cities, *e g.*, Calcutta and Cawnpore, and the principles which we shall endeavour to lay down and the measures which we shall propose in the case of Bombay will serve to some extent as amplifications of our foregoing proposals, for adoption elsewhere if necessary.

In our description of Bombay in Chapter II, we have given an account of the labouring classes, the sources from which they are recruited, and the nature of their employment. We may, however, draw attention to the fact that mill operatives do not by any means constitute the entire labouring population of Bombay. Dock and godown labourers, employés of the railways and public bodies, and cooly labour generally live under precisely the same conditions, and it would be unfair and useless to confine our discussion solely to the textile operatives.

Conditions under which labour is housed in Bombay City.

241. Much has been written about the housing of the Bombay labourer, and, though the worst is very bad, it is necessary to point out that there has been a good deal of exaggeration of the extent of the overcrowding and of the proportion which the buildings of the worst type bear to the total number. We visited a number of workmen's dwellings, usually known as chawls, under the guidance of officials, mill-owners, and private persons interested in the improvement of the conditions of the working classes. We recorded a considerable body of evidence from all sources, official and otherwise. The existing state of affairs appears to be somewhat as follows.

The worst type of chawl consists of a two-, three-, or four-storeyed building, with single-room units either placed back to back or separated by a narrow gulley two or three feet wide, usually traversed by an open drain. The rooms, especially those on the ground floor, are often pitch dark and possess very little in the way of windows; and even the small openings which exist are closed by the inhabitants in their desire to secure privacy and to avoid the imaginary evils of ventilation. The ground floors are usually damp owing to an insufficient plinth; the courtyards between the buildings are most undesirably narrow and, therefore, receive insufficient sun and air. They are also very dirty. Water arrangements are insufficient and latrine accommodation is bad, though the latter is being steadily improved. A most insanitary smell hangs round these buildings. The rents vary according to the value of the ground, which lies between Rs. 5 and Rs. 30 a square yard. The monthly rent per room is from Rs. 3 to Rs. 7, and the rooms themselves are usually about 10′×10′, with a small verandah in most cases. The share of this rent paid by a particular individual or family is not high in proportion to wages, but even so, the standard of comfort is so low that the overcrowding entailed by taking in boarders or lodgers is readily tolerated for the sake of the contribution to the rent received from them. Villagers, it must be remembered, seldom pay actual house rent, and it is not natural to workers belonging to this class to look on such payments as a just and necessary form of expenditure. Owing to the fact that, on the one hand, the original tenant very commonly takes in boarders or lodgers, while, on the other, the wage-earning population are absent at work for most of the day, and a large proportion of the inhabitants sleep out at night during the open season, and indeed only use the rooms for purposes of cooking and eating their food, it is far from easy to obtain a true idea of the degree of overcrowding that undoubtedly exists. We saw a few cases of three families occupying a single room, and numerous indications of the presence of single adult lodgers in rooms occupied by one or two families. But it is necessary to avoid exaggeration and to take into account the mitigating factors indicated above, such as the habit, which many of the occupants have, of sleeping out of doors. Dwellers in chawls possess a better outfit of cooking utensils than the average village agriculturist, and, though their clothing is usually dirty, they have plenty of garments of quite reasonable quality. They also appear to have an ample sufficiency of food, judging by the amount that is thrown away.

242. The chawls of the worst type do not, it would appear, constitute more than ten per cent. of the whole, although many of the remainder are distinctly insanitary. In the better class of labourers' chawls, especially those built by the Municipality and the Improvement Trust, conditions are of course different. There is more space between the buildings, there are more openings for light and ventilation, wider passages, and a more liberal provision of windows. Sanitary and water arrangements are generally suitable, although not in all cases on a sufficient scale. But it is very doubtful whether, even under Municipal or Improvement Trust management, overcrowding can be prevented, owing to the inveterate habit of the tenants of adding to their income by taking in lodgers. The verandahs, in which the members of the family bathe and dress, are easily overlooked from surrounding buildings, and, to secure privacy as well as to avoid draughts or rain, the inhabitants usually enclose them with matting or sacking. It has apparently proved impossible to prevent the tenants from disposing of rubbish by throwing it down from the upper floors. This practice, in spite of the efforts made to keep the courtyards clean, leads to the presence of a large number of flies and adds to the unpleasant odour which seems to prevail in most labourers' chawls. We are of opinion that the single-storey line is, as a type, superior to the three- or four-storeyed chawl, and have no doubt that the ideal to be aimed at is a single-storey, or at the most double-storey, building with

courtyards or, if possible, double-room units; and in any case ample space round the buildings. That such an ideal is impossible of general fulfilment in the congested areas of the south and centre of the Island, we readily admit. But we strongly support the conclusion reached by the Bombay Development Committee in 1914, that the north-east of Bombay Island and the south-east of the neighbouring island of Salsette should be accepted as the main future site for new factories and for the industrial settlements required by them and by existing industries.

Location of the mills.

243. The distribution of existing mills on the island of Bombay is as follows. There are comparatively small groups of mills in Colaba, at Sewri and Tardeo, with one or two mills in the neighbourhood of Mahim. But by far the greater number of the mills are concentrated between Worli and Chinchpokli. Some outlying mills, and one or two even in the more congested areas, possess sufficiently large compounds to permit of the erection of workmen's dwellings on land already in their ownership, or can find land at a reasonable price in their immediate vicinity. But even so, there is no practicable means of securing that the labourer so housed will work for the mill which has provided him with housing, owing to the immediate proximity of other mills, the capriciousness of the mill labourer, and the practice of recruiting mill hands through the semi-independent agency of jobbers. Striking instances of this were brought to our notice in the case of two mills, where only 57 per cent. of persons using the accommodation provided by the mills worked in those mills. These facts will be found important in fixing the responsibility for the housing of labour.

The Bombay Improvement Trust.

244. The Bombay Improvement Trust is the body which at present discharges the duty, so far as it devolves on the local authorities, of providing accommodation for the poorer classes. In the course of effecting improvements it has dishoused about 72,000 persons, of whom 53,000 have been provided with accommodation, mainly by lessees of the Trust. The Trust itself has provided 4,630 rooms in permanent and 953 rooms in semi-permanent chawls. The total average population of these was 18,247. The rent varies from Rs. 3-4 to Rs. 5 per room. The average capital cost of land and buildings per adult housed in permanent chawls was Rs. 286.

The Trust, after completing the programme of road improvements laid down for it by the Bombay Government in 1909, is, it is stated on page 35 of its annual report for the year 1915-16, in a position to take up the erection of chawls and the improvement of slum property in new schemes of an unprofitable nature, provided that the aggregate loss on such schemes, as expressed in terms of present value, does not exceed Rs. 122 lakhs.

Suggested schemes for dealing with congestion in Bombay City.

245. We had before us the following schemes :—

(1) The Improvement Trust scheme, which offers an employer the option, on payment of a deposit of 20 per cent. of the total estimated cost, of having land, if necessary, acquired and buildings erected for him by the Trust, on its standard plans. The buildings are then made over to the employer on lease for 28 years, the annual payments being fixed at a sum which, together with the initial deposit, is sufficient to pay interest and sinking fund charges, with the result that, after the end of the period, the building becomes the property of the employer. Though this experiment was started in 1913, only one mill has so far availed itself of the scheme. Under pre-war conditions the estimated cost was Rs. 700 a room. Under war conditions, this figure rose to Rs. 972; and it may be a long time before the cost of building in Bombay returns to

normal figures. Taking Rs. 972 per room as a basis, with cost of management and maintenance and 6 per cent. on capital cost to cover interest and sinking fund charges, the rent would work out at Rs. 7 a room. This figure should be reduced by the amount of sinking fund charges, which come to 2 per cent.; but even so, the resulting rent is a high one, and will probably be paid only at the cost of overcrowding. The general inability of the mill-owner to make certain of his building being occupied by his own mill hands only, and the high cost of construction, involving high rents, probably account for the fact that the proposals have so far failed to prove attractive.

The scheme is, in our opinion, good so far as it goes, but does not seem likely to afford a solution of the problem without other measures of a wider scope, which we shall propose below. The Improvement Trust scheme might, we think, be continued *pari passu* with these.

(2) Another proposal was put forward on the following lines. The land should be acquired at the cost of Government in suitable areas adjacent to the different groups of mills. The buildings should be erected by the Improvement Trust, and should acommodate all the single adults and (eventually) two-thirds of the families employed. The buildings for the former class should be let at an economic rent to chawl-keepers, under the joint supervision of the Municipality and the Improvement Trust; the others to the families direct, the mill-owners contributing Re. 1 per month per room towards the rent. Recreation grounds, schools, crêches and dispensaries should be erected by the Municipality in the neighbourhood of these tenements.

This scheme has the merits of recognising the responsibility of employers and the difficulty of inducing operatives to pay an economic rent under the conditions now existing in Bombay. But the basis on which the co-operation of employers is to be obtained seems to us too narrow to obtain the desired ends.

The case for and against compulsion to employers.

246. The question whether employers should or should not be compelled individually to house their own labour has arisen in an acute form in Bombay; and we have, therefore, entered into a somewhat prolonged discussion of the relevant factors. The Bombay Development Committee in their report proposed that 'mill-owners' should be compelled to take advantage of the Improvement Trust scheme, though their assertion of the principle that employés should be housed close to the factory or within easy reach of it, would make it appear that they contemplated the erection of the undesirable three- and four-storeyed chawls. As against the principle of individual compulsion, there is, first, the fact that, so far as we have been able to discover, in no country have employers been compelled by law to house their labour. In reply to this it is urged that Indian labour is weak and unorganised, and bad housing conditions in a tropical country are more harmful than in temperate climates. But Indian industrialists, in spite of the large profits which they have in many cases been enabled to earn under war conditions, are in a less strong position than their western competitors, both in respect of accumulated resources and financial facilities, and owing to the lack of traditional skill among their operatives and to the absence of a competent supervising class. To impose on individual concerns what must in many cases be a heavy financial handicap, would be undesirable and unjust. This burden would fall very unevenly on different mills, according to the financial position of each concern and the cost at which land for housing would be available in each case. There is the added objection that, in Bombay at any rate, where the case for compulsion is the strongest, it would be impossible, as already pointed out, for employers, if

compelled to assume responsibility for housing their labour, to ensure, without an impracticable degree of interference, that the accommodation so provided is used only by their own employés. It would be manifestly unjust to employers to compel them to build houses for their labour, unless that labour was equally bound to occupy them. Again, it would be most unfair to limit compulsion solely to mill-owners, while not enforcing a similar obligation on the employers of other classes of labour, and a difficulty would be found in applying it to smaller employers, or in deciding where the line should be drawn. Finally, there are objections, from the labourer's own point of view, to the creation of a general system of landlord-employers, which would tend to keep labour too dependent on the latter. This position cannot always be avoided, but it should not be the object of our policy. Though, as we have stated, we are opposed to the principle of enforcing responsibility on employers by compelling private industrial concerns to house their own labour, we fully recognise this responsibility, and shall propose means for effecting its enforcement collectively, and with a consequent lightening of the burden by distributing it over a wide basis.

247. We have recently seen proposals of the Bihar and Orissa Government for compelling coal-mine owners to house their own labour. But here circumstances are very different. The population of a coal field is not an administrative unit like that of a large city, with a diversity of livelihoods but a common interest in the success and prosperity of all of them. The entire income of the coal fields is derived from the coal and, therefore, from the coal-raising concerns. The income-earning power and prosperity of Bombay, on the other hand, are by no means entirely dependent on industries. The Municipality of Bombay is a body which represents, and can reach with its taxation all classes of the community; and it has a well-established entity of its own. Where, as in the coal fields, such an organisation does not exist, it may be necessary to throw on individual owners the responsibility for housing their labour, a responsibility which, owing to the natural conditions of mining, is usually accepted by owners in actual practice. We think, therefore, that proposals regarding a coal field are scarcely a precedent for the imposition on individual employers of the duty of compulsory housing in a big city.

Responsibility for the financing of industrial dwellings in Bombay.

248. Before putting forward our suggestions as to the lines on which the present state of industrial housing may be improved in Bombay, we think it necessary, in view of the suggestions for Government assistance that have been put forward, to discuss briefly the degree of responsibility attaching to the various public authorities that may conceivably be called upon to contribute. We would, in the first place, point out that, though the economic area which exports through Bombay is interested in having a good market for its raw products, especially cotton, and in the existence of adequate facilities for their transport by land and sea, it is not concerned with the question whether the raw product is manufactured in Bombay city or elsewhere. Indeed, it may be argued that, from this point of view, the general interest of the area concerned will be best served by the encouragement of the existing tendency to establish mills in various localities up country, such as Ahmedabad, Sholapur, and Indore. On the other hand, the city of Bombay is directly interested in the question of housing its operatives. We consider, therefore, that the largest share in the cost must necessarily fall on the city of Bombay, as represented by its Municipality and Improvement Trust, but we think that the importance of Bombay, both as a city and as a port, warrants some measure of assistance from the Local Government. The co-operation of employers is also necessary, and we shall indicate below the manner in which we think it should be secured.

Recommendations regarding congestion in Bombay City.

249. In framing our proposals dealing with the housing question in Bombay, we have to keep in mind two points of view; firstly, the avoidance of future congestion, and secondly, the amelioration of the existing state of affairs. On the first point, we generally support the recommendation of the Bombay Development Committee. We consider that no industrial concerns should be started in the future, except in the north-east of the island of Bombay or in south-eastern Salsette, without the sanction of the Municipality, which should be withheld in cases where the location of the proposed industry is likely to produce congestion or is otherwise unsuitable; and that an adequate scheme of drainage and water supply should be put in hand to prepare the areas set aside for development, not only for industries but for industrial housing. Any industry which may start in the northern area will probably have to provide its own housing; and the requisite powers, including the power to determine whether or not a certain class of industry may be admitted to certain sites, should be taken by the local authorities, to ensure the development of the settlement on proper lines and to prevent the formation of slums or insanitary *bustis.*

250. Bombay is peculiarly unfortunate in having the main workshops of two large railways situated actually in the city, a state of affairs which exists in no other large town in India, and certainly should not be allowed to continue in Bombay any longer than can be helped, or be repeated elsewhere. The railway companies should, therefore, be induced, as much in their own interests as in those of the general public of Bombay, to locate their new shops, the building of which cannot be long delayed, at a reasonable distance from the city, even further afield than the industrial area proposed above, if possible; and should provide housing for their labour *in situ.* No railway, Government department, or public body should depend for the housing of its labour on notoriously congested areas, whether in Bombay or elsewhere. Housing of a suitable type should be provided, and, where practicable, in the northern industrial area. Improved means of communication, including the electrification of suburban railways and the extension of the tramway system, will in any case be required; and these will help to induce an increasing proportion of the working population to seek accommodation in the new industrial suburb.

251. With regard to industries already located in the city, the existing position must be accepted as a basis, but the conditions can and should be considerably improved. A definite standard for industrial dwellings should be determined, and a programme of building worked out and taken up at the expense of the local authorities, who should then manage the buildings. If the existing resources of these bodies, together with such assistance as the Local Government may be able to spare, are not sufficient for this purpose, then further taxation should be imposed in such a way as to fall mainly on the employers, whose co-operation may most suitably be obtained in this form. Due account should be taken in this event of cases where employers have already made adequate arragements for the housing of their labour.

We recognise that the outlay involved will be very heavy; but though we think it inadvisable to attempt any estimate, we do not consider that the cost will reach an impossible figure. The delay, which has already been allowed to occur, has greatly increased the estimate which would have sufficed a few years ago, and it seems fairly certain that further hesitation will make matters a great deal worse. For every reason, therefore, action should be taken at once.

General Measures.

Factory hours.

252. We have received evidence in one or two provinces on the subject of factory hours. It was generally agreed that mill hands loiter away much of the time during which they are nominally at work, one or two prominent factory owners stating that the operatives did not actually work for more than 8 hours out of the 12 at present permitted by the factory law. Some witnesses said that, if the hours were reduced, workmen would still waste so much time as seriously to reduce the present rate of production. Others seemed to favour a ten-hour day, but were afraid that it would lead, temporarily at any rate, to some reduction of output, which might handicap Indian mills as against foreign competitors. The present factory hours were laid down after prolonged consideration and after an enquiry by a Commission, appointed for the special purpose of examining the conditions under which factory labour worked and of devising suitable legislation. We are, therefore, hardly in a position to make any definite recommendation regarding the hours of employment, a question which requires far more detailed consideration than we have been able to give to it, but deserves, we think, further examination. In other countries it has been found that a reduction of the number of hours spent inside the factory has been possible, consistently with the employment of the machinery for a longer time by means of the shift system, and that shorter factory hours have exercised an important effect in the direction of improving the standard of living of factory hands, and have helped in diminishing the congestion of labourers' dwellings, by giving time for employés to come in from areas situated at a little distance from their work. But further enquiry is necessary to ascertain how far such measures are possible in India; and we recognise that, in any case, until the workers have learned how to use a longer period of leisure more advantageously, such a concession may not be an unmixed benefit.

Improvement of public health.

253. We desire to draw special attention to a note (Appendix L) prepared by the Sanitary Commissioner with the Government of India on the effect which the improvement of public health may have on industrial development. He has, in our opinion, given good reasons for a belief that, with a proper organisation for the care of public health, the efficiency of our labour force, especially in the case of organised industries, could be definitely and substantially increased. His note, we think, also gives ground for belief that the conditions under which industrial labour lives in India can be made far more healthy and, therefore, more attractive. The fact that we received so little direct evidence on this important subject is a striking testimony to the general ignorance of the serious effect which various forms of preventible disease exert on the efficiency of Indian labour. The question of public health is, we fully recognise, one on which much can be said from a far wider point of view than from the purely economic aspect in which we are now regarding it. But we think that the presentment of the case for action will be not the less forcible, if we confine ourselves to the severely practical problem of the loss from preventible disease to employers and employed.

It is clear that the improvement of the health of industrial workers cannot be discussed separately from the question of public health generally, if only for the reason that a large proportion of Indian industrial labour moves periodically from village to city and back again. The Sanitary Commissioner's note indicates clearly the lines on which the requisite organisation for the care of public health must be formed. The existing evils are widespread and can only be dealt with by an equally widespread organisation. Into the details of such a scheme we cannot enter in this report; we have made certain specific suggestions to meet individual defects; but we feel it necessary to point out here that we believe the effect of preventible disease on industrial labour to be very great, while the establishment of a satisfactory organisation to combat it is bound to have appreciable results, and may lead to benefits beyond anything which we can at present estimate.

General welfare work.

254. Measures for the welfare of operatives in India fall under the heads of co-operation, the provision of open spaces and other facilities for recreation, medical attendance, and instruction by various methods and in various subjects. Steps in these directions are being taken by Government departments, by the more enlightened mill-owners, and by private associations like the Servants of India Society and the Social Service League. The necessity of providing open spaces for recreation is generally recognised; medical facilities, when on the right lines, are freely resorted to by the labouring classes, and we would emphasise the urgency for a further extension of these. Co-operative work among labourers and especially among mill hands presents serious difficulties owing to the fluctuating nature of the population and to the lack of a common interest. But their indebtedness and the extent to which they are exploited by the shop-keepers from whom they buy their daily supplies furnish a very strong case for a special effort. Employers may give most valuable aid in all these directions; and, in particular, by starting benefit and provident funds and by the provision of compensation for injuries, etc., received by their employés, a measure which, though already taken by a few public-spirited industrialists, should be much more generally followed. The encouragement of sports and athletics will improve the health of operatives and increase their interest in life. Finally, there are many subjects on which the urban working classes require instruction. The rules of health, diet, and sanitation; the care of children; the evils of intemperance; all these are matters which require to be constantly pressed on the attention of operatives. The latter question is, in particular, one that affects the standard of comfort and the efficiency of labour very deeply, and we feel it necessary to point out the temptations that the existing facilities for liquor drinking put in the way of the workmen, and the necessity of removing the liquor shops as far as possible from the neighbourhood of mills and factories, and of providing alternative attractions in the form of places for the sale of temperance beverages. Libraries and reading rooms will afford means of instruction, as well as of amusement, and the same may be said of cinema displays. Street or indoor lecturing is also often a useful method of imparting knowledge or awakening interest. Employers might give occasional opportunities for moral and religious instruction, especially where they have provided accommodation for workers in large settlements. It must be recognised, however, that official organisations, as at present constituted, are ill suited for work of this sort, and nothing really substantial or satisfactory can be accomplished without the disinterested labours of private individuals and associations, which, with one or two brilliant exceptions, have, so far, been sadly lacking. Government and local bodies as well as employers, however, can and should assist such efforts, both financially and in other ways; but the direct participation of official agency in social welfare work must wait until the civic sense has become more fully developed, and we therefore think it out of the place to make definite suggestions.

CHAPTER XVII.

COTTAGE INDUSTRIES.

Present position of cottage industries.

255. One of the most striking features of Indian industrial life is the vitality of the old domestic industries, and in a previous chapter we have briefly indicated the reasons for their survival in the face of factory competition, both Indian and foreign. The instances to the contrary, however, are instructive. The spinning of cotton by hand has entirely disappeared. In the towns, the work of paddy pounding, wheat grinding and other laborious home industries is being more and more performed by power-driven mills, and for social and economic reasons no one will regret the change. The relief of women from these household burdens is a step in advance, and leaves them leisure which they may in the future devote either to more cultured domestic occupations or to more productive work. The part played by women in cottage industries in India includes only the less skilled operations, except in Assam and Burma; in these provinces they carry on the whole business of weaving, and in Burma they also take an important share in other skilled manufactures.

Apart from the beneficent changes brought about by the cotton mill, the rice mill and the flour mill, modern industrial enterprise has left India in substantial possession of its cottage industries. The imports from abroad and the products of Indian factories have been absorbed by the largely increased demands of the country. Nevertheless, it must be admitted that the condition of village artisans is far from satisfactory and that they are, in earning capacity at any rate, in an inferior position to the employés in organised factories. It must be assumed that cottage industries have survived because they are so far adapted to their environment. The artisans produce commodities which are in demand and so far have not been displaced by factory-made goods, and they work under conditions which they prefer to factory life. It must not be imagined, however, that the artisan of to-day is wholly uninfluenced by the industrial changes of the past century. His methods remain the same, but in some instances he works with superior raw materials and in others with better tools. The weaver has taken to mill yarn, the dyer to synthetic dyes, the brass and copper smith to sheet metal, the blacksmith to iron rolled in convenient sections, in each case with advantage to himself from the lessened cost of production, which has greatly extended his market. In some districts in lower Bengal, the weavers use the fly-shuttle slay extensively; and they have recently adopted it in large numbers in the coast districts of the Madras Presidency, while it is also gradually coming into use elsewhere. The tailors invariably employ sewing machines, and town artisans readily take to improved tools of European or American manufacture.

A general review of the evidence tendered to us, supplemented by numerous inspections in the towns and villages that we have visited, confirms us in the conclusion that cottage industries are a very important feature in the industrial life of India; that they are by no means so primitive as they are usually depicted; and that there is no real ground for belief that they are generally in a decadent condition. We have been unable to obtain accurate statistics regarding the actual number of workers in the various cottage industries, but in every town they still form a large percentage of the population, and they are to be found in almost every village, so that their numbers are still vastly larger than those of the operatives employed in organised industries.

Hand-loom weaving.

256. Of these cottage industries, the most important is hand-loom weaving. It is believed that between two and three million hand looms are at work in India, and their annual gross earnings must amount to something like fifty crores of rupees. Hand spinning has entirely died out; accurate statistics are available for the production of yarn, the output of cloth in Indian mills and weaving sheds, and the imports of yarn into India; and it is thus possible to ascertain how much yarn is absorbed in the hand-loom industry. Calculations have been made which show considerable fluctuations from year to year, but, on the whole, a tendency to an increased rather than to a diminished consumption. There is some reason to believe that weaving from coarse yarn is declining, while the medium and fine weavers are chiefly responsible for the increase.

The subject has been dealt with in a separate note (Appendix I), based on the census figures and the returns of production and of sea-borne trade. In connection with this note, we desire to draw attention to the unsatisfactory means provided by the ordinary census for the collection of useful occupational statistics, and to suggest the adoption of special enquiries for this object, which is at least as important as the ethnological discussions that have hitherto figured so largely in census reports.

Metal working.

257. Next to hand-loom weaving, metal working is the most important cottage industry; but there are no means of ascertaining accurately the numbers employed. The goldsmiths are flourishing; the brass and copper workers have undoubtedly felt the competition of imported enamelled iron ware, glass and crockery; but the greater purchasing powers of the people have enabled them to absorb these domestic novelties and to substitute brass and copper vessels for village pottery.

Sericulture and silk weaving.

258. Sericulture based on the mulberry tree or shrub is an important cottage industry in certain districts of Bengal and in Mysore. It also flourishes under State control in Kashmir and Jammu. Other forms of sericulture, dependent on the *eri*, *tasar* and *muga* silkworms, are widespread in Assam, Chota Nagpur and parts of the Central Provinces. Mr. H. Maxwell Lefroy has submitted to the Government of India a very detailed report on the silk industry, which we discuss in Appendix G. Disease among the worms seems to be the silk grower's principal difficulty. The indigenous methods of silk reeling are crude, and there is a case for the establishment of central factories to deal with cocoons. Indian silk weavers largely use imported silk, while the Indian silk is exported from the country for the manufacture of velvets and silk hats. The local silk is full of knots and loose ends, and is of very unequal strength. Consequently, it gives the weaver much trouble to prepare it for the loom, and he prefers the more even re-reeled silk imported from China.

Dyeing.

259. The indigenous dye industry has felt probably more than any other the effects of modern technical progress. When colouring matter was derived chiefly from vegetable sources, the processes were lengthy and laborious and the results uncertain; the use of imported synthetic dyes greatly shortened and simplified the operation and gave more certain results, thus enormously reducing the cost. Many dyers had, perforce, to seek other means of livelihood, and the attempts made since the war to replace the synthetic dyes have established the fact that vegetable dye stuffs are, and always must be, incapable of meeting the demands of the industry on its present scale, both as to quality and quantity. Further, the change in taste brought about by the brighter synthetic

dyes renders it difficult to find a market for the thinner and duller, though perhaps more pleasing, colours of vegetable origin.

Suggested remedies for defects of present position.

260. The cottage industries of India are many; some of them are peculiar to the country; but the great majority are to be found in some form or other all over the world. It is needless to emphasise the artisans' conservatism, lack of ambition and present inability to appreciate a higher standard of living. They are very ignorant, and obviously the first step towards their improvement is to educate them. In most cottage industries the children can be employed at an early age, and it often falls to the woman to take a full share of the work. The care of children is, therefore, apt to be neglected, and they are put to work much too soon with the view of adding to the family earnings. Every gradation of skill and craftsmanship is found in these cottage industries, and, where a higher standard of comfort exists, the necessity for some education is recognised. Various efforts have been made to improve the condition of the artisans, but they have been feebly conceived and ill carried out. The Mission industrial schools deal almost entirely with Christians, and those started by District Boards, Municipalities or private agencies hardly show that the very difficult problem has been seriously considered. Pupils are attracted by scholarships; the training is generally no better than could be obtained in the bazaar, and the bulk of the pupils belong to miscellaneous castes and certainly are not children of artisans.

Our enquiries force us to the conclusion that the crying need of industrial India at the present time is the provision of much greater facilities for the education of the artisan population. Apart from such general measures as Government may find it possible to introduce in the near future, we have recommended the establishment of an efficient system of industrial education in special industrial schools under the control of Departments of Industries.

In modern industrial countries, such as Great Britain, the old system of apprenticeship to master workmen has almost died out; but its decay occurred long after the practical extinction of cottage industries, and it was replaced by a widely extended system of evening classes in polytechnic and municipal technical schools. The conditions here are altogether different. The industrial school in India has achieved little in the past, yet it seems capable of being rendered an efficient means of educating the workers in cottage industries in the future. But no matter what steps are taken to improve the instruction given in the schools, the results will be negligible, unless the pupils can be induced to go through the whole course, so that their training is complete when they leave. The cheapness of living in India is a powerful weapon in international competition; but it is of little avail if the labour is inefficient and unorganised. There is no likelihood of cottage industries becoming extinct; but improvement in the condition of the workers is not probable, unless better tools and plant are employed and an intelligent subdivision of industrial processes introduced. There is a tendency, which will probably be accentuated, to organise small factories, and this should be encouraged. Such a result is, however, more likely to arise from individual capitalist effort than from anything like co-operation among the artisans.

Training of master workmen.

261. The fact that the individual artisan can make a living under the cottage system has attracted the attention of the educated classes in recent years. They have observed that there was room for great improvements in methods and scope for the employment of capital. Accordingly, numerous attempts have been made to start small factories, into which it was intended that the artisans should be drawn. In only a few cases has success been achieved, and

then, as a rule, by men who had acquired a practical working knowledge of the trade in question; but this fact is sufficient encouragement to warrant further efforts in this direction. In each industrial school provision should, therefore, be made for the instruction of a small number of pupils of a higher class with better educational attainments and with prospects of being able to command sufficient capital to start eventually in the trade themselves. In the case of weaving, something in this direction is being done at the Government Weaving Institute at Serampore, where a considerable number of fairly well educated young men are undergoing a course of instruction, which is intended to fit them ultimately to become master weavers. The scheme, however, fails to produce satisfactory results, owing to the absence of opportunities to acquire practical experience in the control of workmen and in the management of a commercial business. There are no hand-loom factories or village associations, in which such training might be obtained, and it is necessary to arrange for a few small undertakings on these lines, if possible under private control, with assistance from Government in whatever form proves most suitable, to serve as demonstrations of work under commercial methods. Failing private enterprise, a purely commercial section should be attached to the larger weaving schools, with the avowed object of supplying the training, other than purely technical, which a master weaver must possess before he can hope to start in business for himself.

We have dealt specially with weaving because of its intrinsic importance. As we have pointed out in Chapter X, however, there are essential differences between weaving and crafts such as, for instance, metal working and carpentry. For these, instruction is needed rather than commercial organisations or the training of master craftsmen.

Financial assistance to cottage workers.

262. We think that attention should also be concentrated on helping the individual workman to escape from the clutches of the money-lender and to obtain credit on easy terms. We make certain suggestions to this end in the following chapter, but, in cases which cannot be reached by the organisation for co-operative credit, Directors of Industries may well be empowered to grant small loans and to supply tools and plant on the hire-purchase system. The difficulties experienced in dealing with this class of worker are well known, and the power to grant such loans must be exercised cautiously; but, while the terms on which they are to be recovered should be easy, the margin between the cost of providing the money and the rate at which it is lent should be sufficient to render the business profitable, as the ultimate aim should be to hand over such transactions to co-operative societies or other agencies.

Artistic industries.

263. In former times the art crafts of India reached a high degree of perfection under the patronage of the rulers of the country. As cottage industries, these arts and crafts are still carried on, and the skill and tradition of each are handed down from generation to generation. But the disappearance of the personal relations between worker and patron has had a disastrous effect. It has deprived the former of his main incentive to excel, and has placed him entirely in the hands of the dealer, who does not require articles which appeal to cultured taste, but merely such as will find a ready sale. There are schools of art in Calcutta, Bombay, Madras, Lucknow and Lahore, but the effect of these on the workers is limited. The Victoria Jubilee Technical Institute in Madras, with funds contributed partly by the public and partly by Government, has a show room devoted to the display of the arts and crafts of the Presidency. Most of the articles are purchased from the people who made them, and they

are all for sale. Only approved exhibits are accepted, and, as quality rather than cheapness is the aim, the Institute is gradually inducing the craftsmen to return to the higher standard of work formerly in vogue, but no longer possible if their only means of disposing of their productions is to sell them to the art curio dealer, who purchases them by the dozen at the lowest rate he can get the workers to accept. We saw a similar institute at Bangalore, and the Director of Industries in the United Provinces has opened a sale room in Cawnpore on somewhat the same lines, though this latter institution is not confined to the sale of artistic productions. These depôts offer promising prospects, but their weak point at present is their lack of a sufficiently aggressive policy. There is no one to instruct the craftsman, to criticise his work and to supply him with new ideas and designs. The men remain isolated in their villages ; and, though there is a permanent display of their productions, there is no attempt, except in Rangoon, where there is, however, no school of art, and in Lahore, to hold periodical exhibitions, where craftsmen may be brought together to compare their work with that of others. Most important of all, the business side is neglected, and the depôts depend almost entirely upon casual visitors for the disposal of their exhibits. No use is made of the ordinary business methods by which sales are effected. There is practically no advertising, and no attempt is made to place the art productions of the country on foreign markets. A bolder policy and more vigorous management should be adopted, and the show rooms and depôts should be more closely associated with the provincial art officers, whose influence over the craftsmen will be greatly strengthened, when the latter find that there is a ready sale for work produced under expert artistic supervision. We have given reasons in our remarks on the cottage industries of Burma (Chapter II), which seem to show that the field for action is specially promising in that province.

The provision of markets for products of cottage industries.

264. An essential feature, in fact, of any attempt to develope cottage industries in India must be the opening up of new markets for the goods produced. Many of these industries have survived because of their ability to satisfy the strongly marked local demands for special designs. But where productions go far afield, it is through the agency of middlemen and merchants, who, however, have so far shown little enterprise or originality in the necessary directions which we have indicated above. We need only mention the toy industry of Germany, the straw-plaiting work of Luton, and the many cottage industries of Japan, as examples of what can be done when enterprise and organisation take in hand the marketing of goods. This really pressing problem confronts any one who would try to put the cottage industries of India on a better footing. Where a greater demand for their products has been created, the artisans have almost invariably sought on their own initiative to improve their means of production, but it requires capital to establish new markets, and in a subsequent chapter we make specific suggestions for dealing with this problem.

Not a little of the industrial success of modern Japan is due to the attention that has been paid, not only to the education and technical training of cottage workers, but to the building up of business organisations, which take over the products of their industry and dispose of them all over the world. The little that has been done in India in this direction is full of promise ; but it is almost entirely for internal trade. From the great centres of indigenous weaving and metal work, goods are sent far and wide, but usually only throughout India. The staple products of Benares, Aligarh, Moradabad and Madura, to mention but a few of the larger towns where these industries flourish, are found in most parts of the country, but little or no attempt is made to cater for foreign markets. The nature of their demand, actual or potential, is unknown, and there is no one to direct attention to their possibilities. It is true that in the south of India there is a considerable export trade in what are known as Madras handkerchiefs and Singapore *lungis*, both products of hand-loom weaving and both specialities which find no sale in India. But Indian merchants have undoubtedly neglected the potentialities of cottage industries, and have done nothing to encourage the workers to produce goods of a class which would find a ready market outside the country. The Swadeshi Stores in Bombay are a good example of an active and successful agency for the internal distribution of the manufactures of cottage and other Indian industries, and they have been evidently of great assistance to a number of cottage industries, by making known to dwellers in large cities like Bombay and Poona what other parts of the country are producing. If the Departments of Industries work in co-operation with a business institution of this sort, they will find it a ready means of introducing the products of both existing and improved cottage industries to extensive markets, while it will in turn derive benefit from the information which the Departments can place at its disposal.

CHAPTER XVIII.

CO-OPERATION FOR SMALL AND COTTAGE INDUSTRIES.

Present position of co-operative effort with regard to cottage industries.

265. Certain difficulties besetting cottage industries resemble problems which, in the case of agriculture, are being solved gradually by co-operation. Co-operative bodies for the distribution of seed have had a striking success on a very extended scale. In some cases, societies for the sale of agricultural products, such as the *gur*-selling societies in the Deccan, have also done well. One or two have been started to work cane-crushing and *gur*-making plant in Mysore, and in several provinces others have taken up the sale of agricultural implements. In the field of industrial co-operation, credit societies seem to have attained the largest degree of success, especially among small urban artisans who live and work in communities, and in particular among weavers. The funds advanced are mainly used for the purchase of raw materials and implements, or to finance the sale of finished products. In addition to these, there are also a few societies which deal solely with production or distribution or a combination of these. The scale on which co-operative credit societies are at present working is very small, when compared with the vast field for their services offered by the millions of small agriculturists and village artisans in India; but they have been at work sufficiently long to enable certain conclusions to be drawn regarding their possibilities.

The following principles seem to be of general application in the case of all co-operative bodies, agricultural or industrial, that deal with purchase, production or distribution.

266. In the first place, before any such movement can be organised, the ground must usually be prepared by the educative influence of co-operative credit, the simplest and most readily accepted form of co-operation in this country. In the next place, the central banks, the secondary co-operative bodies which are the main financing agents, look with considerable and quite justifiable doubt, on societies of a new type, until their soundness has been thoroughly established by success, and, not least so, on industrial societies the members of which cannot offer landed security. Again, in many cases, especially in those which require some degree of technical skill or knowledge on the part of the agents employed, or need a more widespread organisation than a single credit society can offer, it is better to work through co-operative bodies founded *ad hoc*, or unions, as they are often called, than to entangle ordinary primary societies in responsibility for work which is not understood sufficiently by many of their members and makes too large a demand on the capacity of the societies. It would, for instance, be undesirable to saddle a small credit society, of which perhaps only half of the members grow cane, with the task of financing and looking after a cane-crushing and *gur*-making plant. Mutual acquaintance and trust are necessary assets in the case of a primary credit society; but a primary weavers' society small enough to fulfil these conditions would not, in most cases, be strong enough to finance the sale of its output.

Where the products of an industry have a ready sale at a more or less fixed price, co-operative societies for credit or purchase are not difficult to work, but the advantages of co-operative sale in such cases are as a rule not very great. But where the market depends on casual purchase; or is a fluctuating or seasonal one, most of the workers are so largely in the hands of the money-lenders, who take these risks and charge very high rates for doing so, that it is not easy to help them, unless an organisation can be set on foot large enough from the very beginning to finance stocks and arrange sales. Success is more likely to be achieved with readily marketable articles, and the more difficult cases may be taken up, when experience has been gained with the easier ones.

Urban artisans who work individually, such as smiths, carpenters and, in many cases, metal and leather workers, do not readily combine in co-operative organisations with unlimited liability; and without this, their assets are not sufficient to command much credit. A Registrar of experience expressed the opinion that the most hopeful method of helping men of this sort might prove to be through urban banks of the Schultze-Delitsch type, which, though their aims are co-operative, do not work on the principle of unlimited liability, and lend to individuals on the security of two other names.

Suggestions regarding future policy.

267. The main difficulty in the organisation of industrial societies for any purpose which involves dealings on a large scale—the sale of piece-goods for instance—lies in the absence of persons of intelligence and standing acquainted with the business, whose interests are yet not necessarily opposed to the success of the scheme. The cloth merchant is directly interested in maintaining the weaver in his present state of bondage, while few educated persons have sufficient knowledge of the business and sufficient public spirit to be able to organise it with success. There are, in the case of agricultural societies whether for credit or distribution, a fair number of public-spirited landholders, with interests diverging but little from those of their tenants, who have sufficient acquaintance with agriculture to manage the distribution of seed or manure. The need for unofficial and properly qualified workers in this field is very great, and it has been suggested in the preceding chapter that until the deficiency can be met, the most promising policy, at any rate among domestic workers in towns, is either to introduce the small entrepreneur who would organise production by putting out work for partial manufacture in the workman's home and completing it in a small factory; or simply to bring together isolated workers into such a factory and pay them better wages than they can earn themselves under present conditions. Such schemes, if successful, would no doubt add greatly to the efficiency of production, though they would lower to some extent the status of the workers, and expose them to the risk of exploitation.

268. In view of the importance of improving the position of the cottage worker where he is handicapped, as at present, by the want of a free sale for his goods, it is justifiable to incur some risk in experimental efforts. A case or two might be selected, which careful previous investigation had shown to be free from special difficulties, and attempts made to build up an organisation for the sale of the manufactured products. Such attempts have already yielded promising results in the case of the Bengal Home Industries Association, which is a private effort, and in the Government depôt at Cawnpore. But smaller and perhaps specialised agencies are also required for the local collection of articles, which can then be supplied regularly to central institutions or large shops. Such local institutions might be started with Government assistance and control in the first instance, and afterwards converted into co-operative unions. In view of the success which has, in some cases, attended the sale by Government agency of goods prepared by weavers employed as a famine-relief

measure, such a venture ought not in any case to involve serious loss. A scheme of this kind would appear particularly likely to succeed in Burma.

In agricultural or industrial societies, the object of which is the purchase and employment for the common advantage of comparatively costly machinery or plant, it seems necessary, until the confidence of central banks is gained, to give direct assistance in the form of *takavi* loans on the joint and several liability of the members, who should ordinarily be able to offer landed security. This proposal, which is merely an extension of the principle of land improvement loans, has been explained in greater detail in Chapter XX.

Functions of Director of Industries.

269. One of the duties of the Director of Industries should be to initiate industrial societies, especially in cases where fresh ground is being broken, and to afford assistance to them in technical and commercial matters after they have been started. Opinions differ as to how far the supervision of purchase and sale should be considered within his scope. The Director of Industries can obviously have no part in the administration of the statutory provisions applicable to co-operative societies. But he should be responsible for advising the societies on matters involving technical detail, on the provision of new markets for products, and on the commercial aspect of proposed schemes. Whether and how he should deal with agricultural societies organised for the employment of machinery, such as cane-crushing power plant, must depend on the decision reached regarding the control of agricultural engineering work.

The intimate connection between co-operation and the improvement of agriculture and cottage industries cannot be too strongly emphasised; and the officers who control these three branches of administration must recognise this connection, and develope it by keeping very closely in touch with each other, if they are to achieve genuine success in the discharge of their duties.

CHAPTER XIX.

INDUSTRIES AND TRANSPORT.

Effect of railway rates on Indian industries.

270. We received from witnesses a number of complaints to the effect that Indian railway policy does not tend to foster the industries of the country. On the other hand, those who have been favourably treated or are satisfied with the existing position are naturally silent, and the case has, therefore, been only partially represented to us.

The question of railway rates, is a very difficult one, requiring a wide range of detailed and technical knowledge for its proper understanding and still more for its efficient treatment. But there are certain general principles which stand out clearly and seem to bear directly on the specific subjects with which we are dealing. Our recommendations will be of more practical use if we avoid detail and frame them on broad and simple lines.

General course of traffic and its effect on railway policy.

271. Before the war, the major portion of Indian railway traffic flowed in two streams—raw products moving towards the ports for export, and imported manufactured articles moving up country from the ports. Of these the first was by far the greater. The policy of the railways has been based on this position and has followed and tended to stimulate these movements of trade. Large volumes of traffic can, it is true, be more economically handled than a number of casual driblets; but there has also been rivalry between Bombay, Calcutta and Karachi to supply with imported goods the debatable land where their respective railway systems touch, and to attract produce from it for export. The competition between cheap river transport by the Ganges and the East Indian Railway which runs alongside that river has caused the latter to lower its rates in some cases, leading to a corresponding reduction of rates by the Great Indian Peninsula Railway. The influence of the large shipping companies has also not been without its effect on the railways serving the ports; a line of steamers naturally wants goods conveyed to it as cheaply as possible, and can offer a railway serving its port of call important help in attracting traffic to that port. Coastwise traffic has also in many cases had a considerable influence on railway rates. In consequence many inequalities have arisen between goods for export or imported articles on the one hand and goods for internal use or locally manufactured articles on the other, in areas where railways compete with one another or with water transport; and speaking generally, favourable rates for raw produce moving to the ports have resulted. We are naturally not in a position to prove that in any individual case these rates are unnecessarily low. But the history of rate fixation reveals a desire to divert traffic from one Indian port to another, rather than a careful examination of the effect which the rate imposed would have on the total cost of conveying the goods to their port of foreign destination, and therefore on their ability to compete with products from rival sources. Presumably relevant local circumstances are duly taken into account when rates are fixed; the point which we desire to make is that there has been a tendency to think of attracting traffic to a particular railway rather than to consider whether a real necessity exists for reduction in the general interests of the country. Indeed it is possible that a moderate increase would not materially affect the

quantities coming forward. As an example of undue reduction of rates on exports, we would quote the case of hides. Their production cannot be affected by railway rates, though their disposal may be ; and the grant of port rates nearly 50 per cent. less than the internal rates has certainly discouraged Indian tanning, and aided certain foreign industrialists to obtain a hold on a class of raw material of which India possesses a partial monopoly.

The fixation of railway rates on imports has followed much the same lines as those which we have discussed in the case of exports.

It would be easy to support the statements made above by numerous instances ; but the facts are generally admitted. The fixation of a single rate is governed by so many considerations that the citation of individual cases would often be unfair, if each were not fully analysed.

Necessity for a change in rate fixation policy.

272. The efforts of the country in future will be directed to bringing raw materials to the most finished state possible before export; indeed, appreciable advances in this direction were already being made before the war, and the policy underlying the whole of our recommendations depends on the acceptance of this desideratum. The governing principle which, we think, should be followed in railway rating, so far as it affects industries, is that internal traffic should be rated as nearly as possible on an equality with traffic of the same class and over similar distances to and from the ports. This principle must of course admit of numerous exceptions, in consideration of the competition of water transport, the cost of working particular sections of line, the convenience of handling, the advantage of return with full loads, and many other factors. But we would press for its acceptance as far as possible in the case of raw materials conveyed to, or manufactured materials conveyed from, an Indian manufacturing centre.

We are well aware that numerous concessions have already been made for the benefit of Indian industries ; we have seen a long list of such in the case of the East Indian Railway in particular. But our principle premises more than individual concessions ; it involves the necessity of considering from the widest possible point of view, how far the existing low rates on produce for export are really required : equality may be better attained by raising a rate which is needlessly low, than by reducing one which is not intrinsically too high. It would, we recognise, be most unwise to set on foot a policy of individual concessions to industries, without laying down any general principle to guide and limit them ; one concession of this kind involves an incalculable sequence of others, and the eventual loss of income is likely to be very serious. We do not, of course, entirely bar the idea of individual concessions, and we shall indicate later the lines on which we think these may be safely given. But if existing inequalities are redressed on the basis that we have suggested, the necessity for such concessions will be less. We may draw attention here to the substantial rise in the price of raw products and in running expenses, which is likely to continue in many cases for long after the war. This is an added argument in favour of the reconsideration of the existing low rates for moving freight to the ports. We are aware that in 1916 these rates were raised under the general orders of the Government of India, apparently with the idea of maintaining, so far as possible, the distribution of traffic reached by past competition, while restoring to some extent the rates which that competition had reduced. The position should, however, be examined again from a wider standpoint than that of war time, and in estimating the effects of rating the criterion should be what the traffic can stand over its whole journey to the port of foreign destination.

Other effects of individualistic railway policy on rates.

273. We have pointed out above that one of the immediate causes for the low port rates was the competition between rival railway systems, which led them to look on some questions from an unduly individualistic point of view. Another instance of this attitude lies in the 'block rates,' or higher mileage charges for short lengths imposed on traffic moving from a station near a junction with another system towards the junction, in order to travel a much longer distance over that other system. Similarly, when 'scale' or 'tapering' rates are charged, which involve a reduction of mileage rate increasing with the length of the lead, each railway treats the length on its own system as the sole basis for its charges, irrespective of the total lead, and a consignment which divides a journey of 300 miles equally between three railways only obtains the mileage rate applicable to a lead of 100 miles. 'Terminal' charges are also sometimes used for a similar object, *viz.*, to extract as much as possible from traffic which will presumably travel a greater distance over a foreign line than over the line of its origin. There may be justification for these expedients in many cases, but it would appear that they often affect traffic undesirably. They have accentuated inequalities, and have, on the whole, tended to operate to the disadvantage of internal traffic and, therefore, of Indian industries. We think that railways should accept the principle which is followed in some other parts of the world, that a consignment travelling over more than one line should be charged a single sum based on the total distance, any special claims for extra cost incurred by a particular line in handling short-length traffic being met by the grant of suitable allowances or of a suitably larger share to the less favoured line, when dividing the total payment between the railways concerned.

The congestion of industrial centres.

274. An incidental effect of the policy that has stimulated traffic to and from the ports has been the congestion of industries in port towns. The same advantage of favourable rates, granted to a less degree at other important traffic centres, has had similar, though less marked, results in their case also. We have found it necessary in Chapter XVI to comment at length on the serious labour difficulties created by the concentration of industries in certain centres, and we think that the railway rate policy which we have recommended would help to diffuse and decentralise industries, and thereby increase the availability, the comfort and the efficiency of labour.

Effect of proposed policy as applied to imports.

275. We have suggested an examination of the desirability of raising the existing low rates on raw materials for export; we think it equally necessary to do the same in the case of manufactured articles or materials imported. We may quote, without entering into details, the instance of sugar, the increased import of which coincided with the reduction of rates brought about by railway competition. Relevant points for consideration in such cases are how far the reduction benefits the ultimate consumer, or is appropriated by the manufacturer or middleman; and whether any of these persons really needs the concession. We would, however, point to the necessity of one exception to this principle in the case of imports. Machinery and stores destined for industrial use in India should be transported at the lowest rate possible; this will repay the railways many times over in subsequently increased business in other ways.

Miscellaneous difficulties of industrialists.

276. There are other difficulties affecting industrialists, of which we received complaints. The shortage of wagons, the inconvenient routing of traffic, unnecessary breaks of gauge, losses from careless handling or from dishonesty, the question of risk notes and the like were frequently mentioned to us by witnesses, and are commonly discussed in the press by business men and by bodies

interested. Into the merits of these questions we are neither prepared nor desirous to enter; but we are sure that the more effective representation with the Government of India of the industrial and commercial interests of the country by a department charged with the task of developing an active policy of stimulation and improvement, cannot fail to do good to the country, and, therefore, in the long run to the railways also.

Representation of industrial interests with Government of India.

277. We recommend for the serious consideration of Government the suggestion that this representation might be increased by appointing a commercial member of the Railway Board. But it is well to add that the power of control possessed by the Railway Department over the railways is limited by contracts in the case of company lines; and so long as these subsist, the only action which the department can take is by way of argument or influence.

We have already stated that there will be more than one class of considerations to be taken into account in dealing with the future railway rate policy. In dealing with questions of overseas trade and the effect of a change of rates on the ability of Indian products to compete at the place of consumption with those from other sources, the Railway Department will doubtless be assisted by the department of Government in charge of commercial interests, which will have the advantage in future of a more efficient system of commercial intelligence, linked with that which is now being elaborated for the British Empire as a whole. In the settlement of railway questions affecting the requirements and production of Indian industries, the proposed Department of Industries should have a voice; and the provincial departments which we have suggested, with their industrial boards, would often take the initiative in such questions. No such organisation for the representation of local industrial interests and the effective presentment of their wishes before the Government of India has existed hitherto, and it is owing to its absence that the claims of industry have not, as a rule, been put forward effectively and authoritatively. The interests of Indian industries and commerce should, we think, be represented at the Railway Conference and at the meetings of the Goods Classification Committee by appropriate officers of the imperial and provincial Departments of Industries, and in particular by the Director of Commercial and Industrial Intelligence, as well as by representatives of British and Indian Commercial bodies. We think it beyond our province to discuss how far, if at all, the relations which exist between the railways and the Railway Department of the Government of India would require modification to render effective the policy which we recommend.

How far individual concessions should be given to industries.

278. We have, we trust, made it clear that we advocate no one-sided policy of administering the railways as a means of subsidising industries, irrespective of financial considerations. We think, however, that favourable consideration should be given to new industries, in cases where the investigations of the Department of Industries show this to be necessary, by the grant of low rates for a term of years. But we would again repeat, that the abolition of inequalities which we recommend would undermine many of the present complaints.

Water Transport.

279. We have examined a number of witnesses regarding the question of river transport, which is especially important in Bengal, Burma and Assam. We were unable to arrive at definite conclusions. We fully accept the desirability of the improvement of many of the existing waterways; but the matter

really turns on the cost of the improvement in relation to the results to be obtained in the case of each scheme, and on the merits of these we are unable to express an opinion. We feel justified, however, in urging that the Government of India should take up the question of improving the existing waterways, as we cannot help thinking that, in the absence of a representative specially charged with their interests, the vested interests of railways have prevented waterways in India from receiving the attention that has been given to them in other large countries with such satisfactory results. The proposal to form a Waterways Trust was prominently brought to our notice at Calcutta, and although we cannot give an opinion on its merits, the prospective advantages seem to be such as to merit the early consideration of Government. If our suggestion be accepted, that the control of communications should be separated from that of industries, the simplified Department of Commerce should be in a position to give greater attention, not only to the utilisation of existing waterways, but to their improvement with the view of increasing the number of channels of internal trade.

We consider it essential that railway and waterway administrations should work together harmoniously for the development of those parts of the country which are served by both, and we commend this question, together with that of coastwise freights, to the attention of the future Department of Commerce. The effect of shipping freights, coastwise and oversea, on transport, although we are well aware of its importance to the trade of the country, is a matter in regard to which we do not feel called upon to make any specific recommendations.

CHAPTER XX.

INDUSTRIAL FINANCE.

Attitude of Indian capital towards industrial undertakings.

280. A detailed examination of modern industrial enterprise in India discloses the fact that, while during the last half century there has been considerable progress in respect of the investment of capital, it has been upon comparatively restricted lines and there has been little enterprise in new directions. In consequence, the major industries of India are few in number and have been till recently chiefly confined to the textile and leather industries and to mining.

During the last few years, however, there has been a very marked broadening of the field of industrial activity, as exemplified by the establishment of the iron and steel works at Kulti and Sakchi, various Portland cement works, the hydro-electric installations in Mysore, Kashmir, and on the Western Ghats, and the extension of the use of electrical energy to a number of large towns. A number of further schemes are to come, and we may expect to see, in the immediate future, far greater utilisation of the water-power possibilities of the Western Ghats; large additions to the existing steel works; the creation of a group of subsidiary concerns to convert the output of the steel works into manufactured products; the smelting of zinc and copper and the production of sulphuric acid on a large scale; the treatment of coke by-products and the production of "heavy" chemicals on a modern basis; the manufacture of textile machinery and mill accessories; the building of steam and oil engines. Some of these projects are under construction; others have been fully worked out and financed, and are ready to be taken up at the close of the war; others again are being investigated by powerful interests. There has been much development in mechanical engineering, due chiefly to the increased needs of the extending railway system and to the general growth of public and private enterprise. This movement has been, however, arrested by the war, which for a time rendered capitalists afraid of new ventures, and has latterly made it impossible to obtain plant, machinery and staff.

Capital in the mofussil.

281. We may now consider the extent to which capital to finance new enterprises is available in India. On this subject we have received a large amount of evidence, an analysis of which yields the following facts. There is a considerable accumulation of capital in India, and to this new savings are being added every year. Some part of these savings is invested directly in the extension of industry. But we must again draw attention to the vast differences in the economic conditions which prevail in different parts of India. Banking facilities do not exist at all for the great majority of agriculturists, and the co-operative credit movement is only in its infancy. Even where branches of banks exist in mofussil towns, they do not unfortunately attract the custom of the small trader or of the agriculturist; nor do either of these, under existing conditions, possess the confidence of the banks. The often illiterate agriculturist views with considerable doubt the deposit side of a bank's business, while the security that he can offer, though good of its kind, is, owing to his unbusinesslike methods, far less tempting to a bank than the business offered by the larger tenant farmers in other countries.

The agriculturist, the rural artisan and the small trader are financed by the *mahajan*, who does not confine his dealings to money, but is often also a purchaser of local products and a dealer in imported articles. He either operates with his own capital, or is helped by a bigger man of his own class; and the latter often has dealings with banks on a considerable scale. The *mahajan* charges high interest; landed security is good, but is not easily or rapidly realisable; debtors are uneducated and have no idea of business methods or of punctuality in meeting their obligations; their income is often precarious, depending as it does on the nature of the season; and, partly in self-protection, the *mahajan* charges a rate of interest which local custom readily tolerates. The larger *mahajans* who finance landowners or regular traders, often lend money on cheaper terms. But even they do not consider that organised industries, except a few well-known and well-established ones with the value of which they are fully acquainted, furnish acceptable security, and when they lend to others, they exact heavy interest. It is only the smaller industrialists who crave the assistance of the *mahajans*. The larger concerns go to the banks.

282. Thus, except for the branches of presidency and joint stock banks and a few local banks, such capital as exists in the mofussil is unorganised, and the transfer of money is a personal transaction between the payer and the recipient. There are very many small towns, each of which carries on considerable business under these conditions and without the aid of banks. The volume of business would often be considered sufficient to warrant the establishment of a branch bank in the case of similar towns in Europe or America, where such banks sometimes open only one or two days a week. But there is in India at present a lack of trained bank employés, owing to the absence in the past of facilities for commercial education and of any regular system of training Indians in banking work, while the country folk do not yet realise the advantages to themselves of organised banking. For these reasons, the extension of banking in the mofussil has been slow. Where, as in the case of the Punjab, too rapid progress was made, it was attended with grave risks and followed by disaster. There was mismanagement at the headquarters of some of the banks, and many of the branches did little but receive deposits.

Those who invest their savings find few fields which are at once safe and attractive. Investments in land by purchase or mortgage still appeal most strongly to the Government official or professional man; and the farmer with spare funds cares for little else, except in a few parts of the country where some form of industry, usually of a simple type, has become recognised as a safe investment. The Post Office Savings Bank attracts deposits from the intelligent middle classes in towns, including Government servants; and to some extent Government paper also has found holders among the same classes, as well as amongst the bigger landholders.

283. The employment of wealth by those agriculturists who possess it follows traditional lines. In those parts of India where excessive subdivision of land is not the rule, well-to-do agriculturists are found owning a fair quantity of jewellery which is worn by their womenfolk, and they keep in addition a certain amount of rupees or sovereigns, a part of which is used for the current expenses of their household and of their cultivation. The rest they hoard against anticipated future necessities or lend to their neighbours. After the harvest, the money which they have lent or expended on their cultivation comes back to them. This seasonal employment of money leads to two results; the locking up of money unproductively during the slack season, and a high rate of interest during the busy period, because money can be used only

for a few months, and during these months it must earn a high rate of interest in order to yield the average return which would normally be available from long-period investments.

In some mofussil areas, small industrial undertakings are started by individuals, family groups or syndicates. But a sense of business proportion is lacking; in certain parts of the cotton tract, the number of ginning factories and baling presses is far beyond the requirements of the crop; and in the great rice-growing deltas of the Coromandel Coast and in parts of Burma, the number of small rice mills established in recent years has rendered barely profitable what was, at the outset, a flourishing industry.

Capital in Presidency towns.

284. We may now describe the state of affairs in the presidency towns where a much larger proportion of the exchanges takes place through banks, and there is greater readiness on the part of some sections of the public to invest. The representatives of well-established firms, European and Indian, who have come before us as witnesses, generally testify to the fact that they themselves experience comparatively little difficulty in obtaining capital for any well-considered proposals which they are able to put forward. The Bombay Advisory Committee are of the opinion that the shyness so often attributed to capital in India does not exist to a marked extent in Bombay city and probably not in the Bombay Presidency. But, speaking generally, and this remark applies even to Bombay, there is a complaint that the existing banking system is too inelastic, and is insufficient to meet the needs of the country, and that, in respect of industries, development is greatly retarded because the banks refuse to advance money for lengthy periods on the security of buildings and plant. However, in the words of the head of a presidency bank:—"The business that a presidency bank may undertake is strictly confined within certain limits laid down in the Banks Act, and the underwriting of industrial capital and investing in, or lending on, the security of shares in industrial concerns do not come within those limits." We have received evidence in favour of a relaxation of the restrictions of the Presidency Banks Act, which prevent loans from being given for longer than six months, and require the security of two names. Practically all the other banks of established reputation, English and Indian, work on more or less the same lines, and the attempt in the Punjab to introduce banking on industrial lines failed, owing, among other causes, to the attempts of the banks to finance long-term business with short-term deposits, and to the fact that they sank far too great a proportion of their funds in a single industry.

The financial difficulties of the small industrialist.

285. Whether in the presidency towns or in the mofussil, the difficulties in obtaining loans and financial assistance which are felt—and of the reality of these we had plenty of evidence—are experienced chiefly in the case of the middle-class industrialists, who are unable to offer the security of approved names, or of stocks which could be readily disposed of. Indians suffer in a special degree from this deficiency; for, among other reasons, they find it difficult to satisfy a bank, whose directorate and superior staff are entirely European, as to their financial position. In this connection it has been strongly represented to us in some quarters that the inclusion of Indian directors on the Boards of the Presidency Banks would promote the extension of their business and increase the provision of facilities for Indian industrialists; and we put forward this suggestion for the consideration of the banks concerned. There is no doubt that the small entrepreneur, whether industrialist or trader, is hampered seriously by the lack of banks and of finance at reasonable rates; and that the extension of facilities has been far too slow and too

limited to meet the needs of the country. On the other hand, such applicants for assistance are often unable to exhibit their financial position in a form intelligible to a banker.

Summary of position.

286. Such are the conditions of rural and urban finance; and it is hardly surprising that, taking into account the general ignorance of industries, money for investment therein, whether on loan or by way of subscription to capital, is not readily forthcoming and the wealth actually possessed does a very small amount of work owing to its inactivity. There is a general demand for Government financial assistance, though there is no unanimity as to the form which it should take. It is stated plainly that the provision of Government funds for an industrial undertaking or a guarantee of interest on the part of Government will attract investors, chiefly because it is generally considered that when Government gives assistance in this form and assumes any part of the financial risks, it will examine the prospects of the undertaking and will be reasonably sure of success. In the case of small industries and of those that are new to India, witnesses complained bitterly that the public are unwilling to invest, that sufficient capital cannot be obtained from the friends and acquaintances of the promoters, and that banks are unwilling to supplement the deficiency or even to provide working capital. Money for such purposes can only be obtained at a rate so high as to swallow up the profits of the venture.

The difficulty in raising capital for industries is mainly the measure, even in India, not of the insufficiency or inaccessibility of money, but of the opinion which its possessors hold of the industrial propositions put before them. We have seen that deficiency in business experience and practical knowledge of the technical details of an industry is often a more serious handicap in the way of its promoters than lack of finance. Thus we found in many cases that, where there were complaints of inability to obtain sufficient capital there had been also initial miscalculations as to cost of buildings and plant, or as to the amount of working capital needed. In other parts of our report we have formulated proposals for placing technical assistance and business advice at the disposal of industrialists; we have now to see whether it is desirable for Government to take any steps towards rendering finance available, whether for initial or working capital.

Industrial Banks.

287. Where industrial enterprise is in a healthy state, opinions seem to be crystallised in the evidence tendered to us by the Bombay Advisory Committee, who state, " We favour the establishment of a central industrial bank or similar organisation with a large capital and numerous branches, designed to afford financial support to industries for longer periods and on less restricted security than is within the power or practice of existing banks. Such a bank would probably require a measure of Government support, but should not be brought under rigid Government control."

The only instance of an industrial bank in India is the Tata Industrial Bank, which was established quite recently and has not yet had time to evolve a systematic policy in dealing with industries, or even to illustrate the possibilities and difficulties of this interesting form of financial activity. Our information regarding the British Trade Corporation, which, however, undertakes other lines of business than industrial banking, is confined to the report of the Committee which recommended its inception and to the many criticisms which have been put forward in Parliament and in the public press on the report and on the terms of the charter, and no actual working experience is available as a guide.

Industrial Banks in Germany and Japan.

288. We have examined such material as we were able to obtain regarding the part played by banks in the industrial development of Japan and Germany. In the latter case, a compendium of the statistical position will be found in a note by the Director of Statistics printed among our records*. The characteristics of the great German industrial banks are, briefly, the high proportion of their paid-up capital to their total cash transactions; the readiness with which they finance industrial and commercial business and participate in fresh industrial ventures, by taking up and eventually selling blocks of shares in such undertakings; and, finally, the large extent to which they retain a control of the industries and businesses which they finance, by appointing their representatives as directors. They have thus been able to make such undertakings help one another and, therefore, the bank; and have at their disposal the wide range of technical knowledge and experience of these assisted businesses to aid them in deciding on the merits of further undertakings. It is alleged that behind these banks stand the Reichsbank and the German Government.

We have recorded evidence on the Japanese banking system, which explains the methods on which the large banks purport to do business. We may consider, as a specimen of these, the case of the Nippon Kogyo Ginko, a Japanese industrial bank, with a Government guarantee of limited duration. The by-laws of this bank, which require Government sanction, forbid the loan of an amount exceeding half of the bank's paid-up capital on urban land or industrial buildings; its debentures may not exceed the value of certain securities held by it, or be more than ten times the paid-up capital; and the bank must not give loans for longer periods than five years. We find thus in Japan a considerable degree of State support and control in the case of banks which are designed to assist the commerce and industry of the country. We were unable, however, to form opinions of value on the effect of these methods in actual practice, and, though we received some information regarding the mutual support obtained by industries through the gilds, we have no precise details as to the extent to which the local banks afford assistance to small industries, a function which, so far as we could ascertain, is not undertaken by the larger banks.

Industrial banks: their possibilities for the assistance of industries.

289. We have now to consider what is the best class of agency for the provision of initial and current finance for industries. The industrial trust or financial corporation for the promotion of industries, which some witnesses supported, is, we consider, in its nature too directly concerned in the success of particular undertakings to be a suitable instrument for the general advancement of industries, though a useful agency for furthering particular industrial interests. The multiplication of concerns in any industry to which it is already committed, will not be welcomed by it. The industrial bank, on the other hand, if wisely conducted, is benefited by an increase in the number of individual undertakings, and it can to some extent prevent their extension beyond the safety point. It is true that in a country like India, where a wide industrial basis does not at present exist, the specialised business opinion and expert advice required by industrial banks are only available to a limited extent; but the latter can be, to some extent, provided from the Government establishment which we have proposed, subject to the conditions laid down in paragraph 127 of Chapter IX. We are not blind to the dangers which attend the giving of advice on an industrial proposal by the Government officer or department; but we feel confident that the successes will so greatly outnumber

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* Minutes of Evidence Vol. V.

the failures, that the general results of such a policy will be advantageous. It is impossible for a bank to retain in its permanent employment a sufficient number of first-class experts to advise it on a great diversity of new industrial undertakings, while, if it confines itself to financing those as to the soundness of which it is able to satisfy itself, its activities will be too restricted to enable it to earn a profit on its necessarily large capital; and it may even have to limit its investments to so small a number of industries as to endanger its own stability. It appears to follow that an industrial bank with a sufficiently large capital to ensure its safe working must, at any rate for some time, combine ordinary banking business with its industrial activities to enable it to obtain a return on its capital. But it cannot be too strongly emphasised that, in such a case, the clearest possible distinction must be drawn between industrial finance and ordinary banking business. Share and debenture capital and long-term deposits may legitimately be used for the former purpose, but short-term deposits never; and any attempt so to employ them should be most strictly prohibited, if necessary by law.

290. Judging by the information available from Japan and Germany, an industrial bank can assist in the provision of initial capital, either by examining proposals for starting new concerns and allowing their prospectuses to issue with its *imprimatur*, or simply by providing them with money. This again may be done either by loan or by the purchase of shares.

The provision of working capital for industries that have been started is undertaken by existing banks, but few of these lend money on the security of plant and buildings, or reach the smaller industrialist who most needs help, even when he can offer personal security or a lien on actual goods. An extension of facilities to meet these cases would be of the greatest assistance to small and middle-class industrialists.

What is required, then, is a bank which can keep in touch with small industrialists, is able to estimate the prospects of a fairly extensive range of industries, and possesses funds which it can afford to lock up for a time in securities not readily realisable. A bank that is so equipped will often be able, even if it has in the last resort to take over a factory, to avoid much of the loss which such a course would usually entail on an ordinary bank. It is clear that a limit will have to be placed on the amount advanced on security of this kind, and this should be fixed with special care in the case of money advanced towards initial capital. Plant has, in some cases, a sale value which can be estimated with a considerable degree of certainty; it then constitutes a fairly liquid asset.

291. We are of opinion, therefore, that an industrial bank should possess a paid-up share or debenture capital high in proportion to its total business; it should observe the usual precautions in not allowing too large a share of its funds to be used for the benefit of any single interest or group of financially inter-dependent interests; its loans on plant, buildings and land should be carefully considered and should be limited in each case; the larger portion of its industrial business should be confined to the provision of working capital; it should provide initial capital with caution, at any rate during its opening years, and should not itself at first attempt to float companies, though it may advise and assist in other ways persons who propose to do so. The main factor of safety in an industrial bank is the judicious limitation of each class of business to its proper proportions.

292. We have shown that the lack of financial facilities is at present one of the most serious difficulties in the way of the extension of Indian industries,

Appointment of expert committee proposed.

and we believe that industrial banks, especially under the improved conditions towards which the measures proposed by us are intended to lead, would be a potent means of removing these difficulties and of affording help to industrialists. The Tata Industrial Bank has recently started, with a large capital raised without Government assistance; but we think that there is still ample room for other institutions, especially of a type designed to afford assistance to smaller industrial undertakings. Although, as we shall explain below, there will be cases, particularly at first, in which direct Government assistance should be given to industrial undertakings, we are of opinion that work of this kind can be performed more suitably by private agency, and that Government should hand over all such business to suitable banks as soon as circumstances permit, and should frame its policy with this end in view. We consider that the establishment of industrial banks working on approved lines is of sufficient national importance to justify Government assistance; but we do not feel that we have sufficient material before us to enable us to formulate a definite scheme for industrial banks, whether of provincial or imperial scope. We ask, therefore, for the appointment at the earliest possible date of an expert committee to consider what additional banking facilities are necessary for the initial and for the current finance of industries; what form of Government assistance or control will be required to ensure their extension on sound lines as widely as possible throughout the country; and whether they should be of provincial or of imperial scope, or whether both these forms might not be combined in a group of institutions working together.

Other Measures to provide Financial Facilities.

Provision of current finance for middle-class industrialists.

293. We recognise, however, that the adequate extension of industrial banks will be a matter of time; and we have therefore considered a proposal to meet the need experienced by middle-class industrialists for current finance, a proposal which could, it would seem, be readily merged in any future system of industrial banking.

As we have already explained, the banks have no convenient agency for enabling them to ascertain whether the proprietors of small industrial concerns are working on sound lines and possess a good reputation for honesty and punctual payment. The proposal represents an attempt to supply this deficiency and to bring such men more and more into touch with banks of repute. The scheme would, in the first place, be confined solely to industrial businesses with a paid-up capital of from Rs. 5,000 to about Rs. one lakh. The provincial Director of Industries, assisted by his technical staff and by the advice of a committee of business men, among whom a representative of the lending bank might well find a place, would examine the financial position and reputation of applicants and their methods of manufacture, and would certify those persons whose position was found satisfactory, as suitable recipients for a loan. This would take the form of a cash credit for a definite period and amount with a bank. Government would, under this proposal, guarantee the principal sum lent with interest at a rate to be agreed on with the banks. Any bank of repute would be allowed to participate in the scheme, and applicants would select the bank with which they would deal. Suitable limits, both maximum and minimum, would have to be fixed for the cash credits. The rate of interest to be paid by approved applicants would be a matter for Government to decide. The latter might perhaps desire a rate somewhat higher than the rate guaranteed to the bank. Some portion of this margin could then be retained by the bank for its trouble, and the rest be used by Government as a set-off against possible losses. If interest at a rate higher than the bank rate were levied, the bank would find in this an inducement to take over an increasing share of the business, free of Government guarantee. By doing this, the bank would receive the whole of the interest charged, instead of having to hand over some of it to Government. Similarly, if a certified applicant failed to pay his debt, the bank would only receive from Government, in addition to the principal, the guaranteed rate of interest; and the bank would naturally do its best to avoid the loss of its share in the interest in excess of this, by watching the way in which the account was operated and reporting to the Director of Industries anything which showed that action on his part was needed.

It is clear that the success of the scheme would rest almost entirely on the qualifications of the Director and on the nature of the organisation which he would have to create in order to determine the suitability of applicants for help. We recognise also that, as a general rule, the task of ascertaining the soundness of a concern asking for financial aid can be best performed by a banker, and can only be undertaken by Government at some risk. But we have so strongly before us the difficulties experienced by the middle-class Indian industrialist in obtaining financial assistance from existing banks, that we think the scheme deserves consideration, at any rate as an interim measure until industrial banking facilities can be extended. The same principles apply with even greater force to any organisation for the supply of initial capital to industries.

Circumstances in which Government financial assistance may be given to large industrial undertakings.

294. There are, however, still likely to be cases requiring help, which cannot for various reasons be reached by banks, and will need direct Government assistance. We have already indicated the extent to which Government should assist nascent industries by expert advice, by experiment, by demonstration and pioneering; and we may point out that Directors of Industries and their staffs will often be in a position to assist and advise small industrialists regarding the keeping of their accounts, and the form in which they should place their business position before banks from whom they wish to borrow. We consider that preliminary investigation and expert advice by Government will inspire confidence and render possible the starting of many industrial enterprises, for which in existing circumstances private funds are not forthcoming. But there will still, we recognise, be occasional cases in which this will not be so, and more direct Government aid will then be asked for. The advisability of giving such aid depends on the extent to which the starting of the enterprise in question will be of benefit to the public, and not merely on its probable advantage to the promoters of the industry. Thus, the starting of a new or the improvement of an existing industry, when such a measure is required to supply an existing deficiency in the interests of national safety, is clearly a case for direct aid. There may also be a few cases where a new industry or process will have such an important bearing on the economic development of the country as to deserve Government help. Finally, it may even be found that the extension of an existing industry to a new locality will benefit local consumers or producers so markedly as to merit Government assistance. We think that in the majority of instances private funds will be forthcoming without direct Government aid, to finance proposals put forward under any of the above conditions, if Government advice and technical assistance are freely utilised. But where private enterprise is unable to obtain funds without Government aid, and where, with such aid, prospects are promising, we think that, in the circumstances described above, it should be given. Financial aid of this kind, if for undertakings required in the interests

of national safety, should be solely a matter for the Imperial Government; in other cases, it should, subject to their general powers of financial sanction, be within the competence of Local Governments, where they possess the necessary expert staff. In practically all cases of Government aid to an industrial enterprise, action is necessarily to some extent experimental, and favourable results may be of great importance to future undertakings as well as to Government. We have noticed that in a few instances in which Local Governments have granted aid to industries, conditions were not so arranged as to permit of reliable inferences for future guidance being drawn from the results attained. It is, therefore, essential that, with due regard to the interests of the undertaking itself, any such experimental measures should be as far as possible crucial, as regards both conditions and scale of working. Principles will be thus ascertained and a definite policy established, which should render possible a still further degree of delegation in favour of Local Governments.

Nature of Government financial assistance to large industrial undertakings.

295. Government assistance may take the form of guarantees of dividends of loans of money, or of undertakings to purchase output, as may appear most suitable in each case. Thus guarantees may be appropriately given in the case of large industries, in which the dividend-earning stage is likely to be reached only after a comparatively long period. As a general rule, any sum paid by Government by way of guarantee should be refunded from the subsequent profits of the enterprise, when these have reached a certain predetermined percentage; and the guarantee should be only for a limited number of years, and at a somewhat higher rate than that which Government paper can be bought to yield. Loans are especially suitable in the case of concerns with assets of a comparatively liquid nature, but need not be confined to these, if Government is fully satisfied as to the prospects of the undertaking. Agreements to purchase output may be freely given to concerns manufacturing articles not previously made in the country, and, in other cases, with greater caution and with due regard to existing interests in India. Such agreements should be limited in point of time, and should be accompanied by suitable conditions as to quality and price. The output must, of course, be of articles which Government requires for its own purposes. There may be a few industrial ventures which Government may consider of importance to national safety, but does not desire to undertake by its own agency, though it thinks it necessary to have a continuous and effective voice in their management. In such cases, especially where sufficient private capital is not forthcoming, Government might contribute directly towards capital resources as a shareholder. The general effect of the measures suggested will be greater and will be in the direction where it is most needed, if ventures of moderate extent receive preference and the requirements of comparatively undeveloped districts are not overlooked.

Government supervision in such cases.

296. Before giving assistance which involves a charge on the public funds, Government should satisfy itself regarding the financial status of the promoter and the economic and technical aspects of the proposed industry. The latter information may be collected either by Government or by the promoters, so long as the agency employed is of a nature to command confidence. Where any form of Government financial assistance is given, we consider it desirable that Government supervision should at least include audit and inspection, and that it should be secured by suitable agreements that the objects aimed at by Government will be fulfilled; also that, where guarantees are offered, unfair encroachments on the earnings of the undertaking should not be permitted to other interests.

Appointment of Government directors.

297. In certain cases it may be desirable, especially in the early stages of an undertaking, to appoint a Government director, who need not, however, be an official. We realise that in the case of railways, where a well-established policy has been developed as the result of years of experience, a Government director can safely be allowed to exercise the power of veto; but in the case of commercial companies, where promptness of action is essential, Government interference, unless on carefully adjusted lines, would be liable to cause delay leading to very serious losses. Ordinarily, therefore, we consider that the functions of a Government director should be limited to reporting to Government the action contemplated or taken by the company, where it is of a nature demanding Government attention, and that he should not have to refer such action for sanction.

Raising of capital for aided companies.

298. We consider that, where industrial undertakings receive Government aid, *e.g.*, by way of guarantee or subscription to share capital, their capital should be raised in India in rupees. In order to secure that the opportunity of subscribing to such undertakings is fully open to all classes of the public, we think that Government should control the allotment of shares, for example, by formulating rules designed to give an opportunity to small investors of joining in industrial enterprise, and to induce the Indian public to take an interest in industries.

Undertakings by companies in consideration for Government assistance.

299. Similarly it is desirable in such cases for Government, so far as the circumstances admit, to obtain some *quid pro quo* for its assistance, which may take the form of an undertaking to sell certain products to Government at a favourable rate and within certain specified limits of quantity, if required; to give priority to Government orders in certain circumstances; or to accept a certain number of apprentices.

We wish to make it clear that the foregoing remarks are to be taken in the nature of general suggestions; rigid prescriptions are undesirable, seeing that in the early stages of a new policy the activities of Government must naturally be regarded as experimental, and should therefore not be unduly fettered by hard and fast rules, the object in view being to foster industries with the minimum amount of Government assistance or interference.

Enterprises in competition with foreign concerns.

300. There is a general consensus of opinion that there should be no limitation on Government aid to a new enterprise, on the ground of its competing with an established external trade.

Special recommendations regarding Government loans to small and cottage industries.

301. Assistance may also be given by way of loans to small or cottage industries and to co-operative societies. This class of loans should be made by the Departments of Industries to persons or bodies whose financial position and character are found on local enquiry to be suitable. Other forms of security than landed property might be accepted, but in such cases a stipulation should be usually made that applicants should find a fair percentage of the total outlay from their own resources. The advice of the members of the Board of Industries or of its local or special committee as to the financial standing of an applicant for a loan would be of value and would usefully supplement local enquiries. We have already stated that all schemes for Government loans to industries should be worked with the object of handing over the business to a suitable banking agency in due course, and the interest on these loans should accordingly be fixed at a rate which would render this course possible.

It should be a condition of the loan that it should be spent on approved types of plant and the department itself might, when desired by the applicant, purchase the plant. There are numerous types of plant suitable for the purposes of agriculture or of small industries, which could be made available by Government on the hire-purchase system. This system has already been followed with some degree of success in Mysore, by the State Department of Industries, and by private concerns elsewhere. We print as Appendix M the rules for hire-purchase in force in the Mysore State, as an instance of a mechanism which experience has shown to be effective.

302. We consider that some maximum limit must be placed on the amount of individual loans advanced and on the value of plant supplied, under this system, but it would be for the Local Government to determine the figure to which the powers of the Director of Industries should extend. We are further of opinion that advances of this kind, whether in cash or by way of hire-purchase, should be made under a special Act providing suitable means for the recovery of outstandings. In the absence of such provision, the difficulty of recovery will tend unduly to restrict the giving of advances. The Land Improvement Loans Act and the Agriculturists' Loans Act do not cover the granting of loans for purposes unconnected with agriculture, nor do they permit of the loan taking the form of plant made over to the recipient on a hire-purchase system. For these reasons, we think that fresh legislation would be required.

CHAPTER XXI.

PROVINCIAL DEPARTMENTS OF INDUSTRIES.

Recapitulation of previous proposals.

303. We have shown in preceding chapters that the economic development of India has been very incomplete, and that its numerous deficiencies have left her exposed to disadvantages and dangers from which a proper organisation of her resources and workers would make her free. This end cannot be achieved, in the peculiar circumstances of the country, without the adoption of a national policy of industrial improvement, covering a number of parallel lines of advance which have been explained in detail. We have drawn attention to the necessity of technical and industrial education, and we have recommended a comprehensive scheme to meet the needs of the leading industries. We have indicated the extent to which the country suffers at present from the lack of organisation among scientists, and we have made general suggestions for remedying this deficiency. We have pointed out the improvements which require to be effected in the Agricultural and Forest Departments and in the Geological Survey, to make them more useful to industrialists and to the country generally. Agriculture is our most important industry and, if conducted on more efficient lines, it will not only supply a greater range of raw materials to industrialists, but will set free some share of the labour which it is at present employing in a wasteful manner. We have discussed the sources of power which exist in India and have made suggestions for their more economical and efficient utilisation. Perhaps the most important of our proposals are those relating to industrial experiment and research, and to technical assistance and advice to industrialists, and we have explained in some detail the different forms that these must take in the case of both cottage and larger industries. The organisation proposed for the aid of the former will require to be supplemented by a system of finance by Government and by co-operative agencies. To meet the financial needs of the larger industries we have made separate suggestions. We have proposed that the purchase of Government stores should be conducted in a way which will encourage manufactures in this country, and we have also pointed out the necessity of an improved system of commercial and industrial intelligence. We have made a number of incidental suggestions regarding such matters as transport, land acquisition and the mining rules, which will, we hope, smooth the path of industrial progress. We have discussed the general position of industrial labour in India, and have tried to show in what ways its efficiency is affected by the surroundings in which it lives and works, and how far these can and should be improved.

304. To carry out these suggestions in the first instance and to maintain the ground won, we require a specific organisation, properly equipped for the purpose, whose duty it will also be to keep a constant watch for industrial developments abroad that may menace the interests of India, and to see that such assistance as can be afforded is not lacking to our industries in their struggle against outside competition. We must emphasise the extensive nature of these proposals, each one of which will involve heavy responsibility in direction, which can only be discharged with the aid of the best expert advice, executive work on a wide scale requiring a numerous staff for its performance, and the expenditure of large sums both by Government and the industrial public.

We are proposing measures designed to assist existing industries, in which many crores of rupees are invested, and to build up new ones which may become of equal importance, with the object of making India self-sufficing both in respect of her industries and of the expert staff which they require. These far-reaching aims can never be achieved without a great effort, in which both the Government and the people must fully co-operate; and for this co-operation we have provided. So far as Government is concerned, the main share of the work will fall to provincial administrations, but in the interests of economy and efficiency alike, some important duties will have to be performed by the Imperial Government, and the latter will, in any case, be responsible for the success or failure of the policy, of which it must assume the general direction.

Shares of Imperial and Local Governments in industrial policy.

305. We have already indicated the shares that will have to be borne in this work by the Imperial and Local Governments, respectively. The control of technical and industrial education, except in the case of two central institutions, one for the highest class of instruction in engineering, the other for metallurgy and mineral technology, for which we think a necessity will sooner or later arise, will lie entirely with provincial Governments, though we contemplate certain advisory functions being performed by imperial agency, to ensure this form of education being maintained on sound lines and to avoid the numerous errors of the past.

By far the greater number of the members of the Chemical Service, which is the one most intimately concerned in industries, would according to our recommendations be placed under the orders of Local Governments, and the Imperial Government would then be concerned merely with questions of the recruitment, promotion and distribution of the staff, and with fundamental research. We have proposed no alteration in the existing allocation of responsibility in respect of the Agricultural and Forest Services, nor in the case of the Geological Survey. In Chapter XIV we have shown that a limited number of special cases exist, where, in the interests of economy and efficiency, the initial measures must be taken by the Imperial Government. But in most cases this work would be done by provincial Governments, who would, as a rule, be responsible for the practical application of the results of investigations, whether carried out by themselves or by the Imperial Government. We have proposed that commercial and industrial intelligence should be collected and utilised in the first instance by the provincial Departments of Industries, which would transmit the information to the Director of Commercial and Industrial Intelligence. The purchase of stores would be dealt with initially by provincial departments, but there are certain important materials which must obviously be purchased by a central agency, and this will, in any case, be required for the distribution of provincial demands that cannot be satisfied locally.

The administration of certain Acts and rules affecting industries, such as the Factories Act, and the Mines Act and Mining Rules, should be controlled by an imperial department, as at present, to avoid inequalities of treatment which would operate unfairly on industrialists in different parts of the country, though the necessary executive work would continue to be done entirely by Local Governments. In respect of financial aid to industries, we have proposed that loans to cottage and small industries, when necessary, may be made by Local Governments; while we think that larger-scale finance must be for the present provided by private agency, though we contemplate the grant of Government assistance in special cases. The welfare of industrial workers must be entirely a provincial concern.

Departments of Industries have been formally sanctioned by the Secretary of State in some provinces (Madras and the United Provinces), and in most others tentative measures of a similar character have been taken by local administrations.

We think that the recapitulation of our proposals, which we have given in this chapter, will show that the responsibilities of provincial Governments in respect of industries can be successfully discharged only through provincial Departments of Industries, which should be controlled by Directors of Industries. In these conclusions we are supported by the almost unanimous opinion of the witnesses who gave evidence before us.

Work of Provincial Departments of Industries.

306. The work of provincial Departments of Industries should fall under the following heads :—

(*a*) The direct encouragement of industries, including a large share in industrial research work, the provision of technical advice and assistance to industrialists, the examination of applications for special concessions, and the grant of loans to small and cottage industries.

(*b*) The collection and distribution of commercial and industrial intelligence; the work of passing Government indents and of purchasing and inspecting certain classes of Government stores; the organisation of markets for local products ; the conduct of special enquiries and industrial surveys ; the holding of industrial exhibitions and the management of commercial and industrial museums.

(*c*) The control of technical and industrial education. This would necessitate the training of staff for, and the inspection of, industrial schools ; the organisation and inspection of apprentice classes attached to large works, and the provision of the staff for the necessary theoretical teaching. The Director would also have to take his share in the control of the higher institutions for technical training. Funds for technical and industrial education would be provided from his budget.

(*d*) The control of the staff employed for the local administration of the Electricity, Factories and Boiler Acts; and the furnishing of advice to Government on the industrial and commercial aspects of the Mines Act and of the rules for mining leases and prospecting licenses.

We desire to draw attention also to the necessity for some means of exchanging information regarding the experience gained in different provinces. Even in respect of cottage industries this is necessary. We found at work in the local weaving institute of a certain province two types of looms, the use of which had been entirely abandoned, and for good reasons, in at least three other provinces which had tried them. We have made definite proposals to secure the exchange of information in respect of technical and industrial education and of the purchase of Government stores. As general measures, periodical publications, occasional conferences, both general and sectional, and inter-provincial visits seem the best means of doing what is needed.

Relations of Department of Industries with other departments.

307. We have further to consider what should be the relations of the Director of Industries with the Agricultural and Co-operative Departments. With regard to agriculture, the functions of the Director of Agriculture would naturally include the collection of intelligence of commercial value regarding the crops produced in the province, which he should communicate to the Director of Industries; though he himself should supply the essential information to the Director of Statistics. Agricultural engineering, including the demonstration to agriculturists of small power plants, should be under

the control of the Director of Industries. In Bombay, where until recently (1918) there was no Director of Industries, this work was controlled by the Director of Agriculture; a similar course is, it is understood, contemplated by the United Provinces and Punjab Governments; and the Madras Government in 1916 placed the Pumping and Boring Department under the Director of Agriculture. The absence or comparative inactivity of provincial Departments of Industries can be the only reason for such a course. Where a well-equipped Industrial Department is actively at work, it seems a waste of control to have one department putting in power plant for agricultural work and another for other small industries, side by side in the same district. The work itself is of a totally different character from that which properly belongs to the Agricultural Department, and valuable adaptations and improvements are not likely to be forthcoming except from a technical department which can control the work of industrial specialists.

The connection of the Director of Industries with co-operative work for industries has been discussed in Chapter XVIII. The intimacy of the relations between industrial improvement and agriculture has been emphasised in Chapter V, and we here again draw attention to the necessity of the provincial departments in question being so co-ordinated as to secure close and harmonious working between all of them. This, we think, may be best attained by placing them directly under the charge of a single high official, preferably a Member of the Executive Council. It is clear that the functions of the Departments of Industries will be both extensive and important, and that they will involve a serious increase in the responsibilities of Local Governments. Skilled control and an expert staff will be required, and full co-operation with industrialists and capitalists must be obtained.

Proposals for a Board of Industries.

308. For the proper control of its staff and the efficient conduct of its work, the department should be supervised by the Director, who should be assisted by a provincial Board of Industries, the members of which should be appointed by Government, in some cases on its own selection, in others on nomination by suitable public bodies. We have attempted below to work out a scheme which would be suitable for those provinces where a wide field of selection exists among persons engaged in large-scale industries and commerce. But we recognise that it may be desirable in other provinces, at any rate at first, to attach fewer powers and responsibilities to the Board.

Three main suggestions have been made :—(1) That the Director of the department should be an executive officer solely responsible to his Local Government; (2) that the department should be controlled by a Board of officials and non-officials, and that the Director should be its executive officer and under its orders ; (3) that the Director should work under the orders of the Local Government, but should be assisted by a Board, of which he would be the Chairman. So far Madras has adopted the first method and the United Provinces the third. No province has accepted the second proposal and rightly so, as it seems to be unworkable. There seems to us to be no doubt that the third course should be generally followed. The Board should not be merely an advisory body liable to have its suggestions disregarded by the Director ; for it will be difficult to get responsible and competent men to serve on such conditions. In respect of all matters not specially excluded from its scope, it should be consulted, and in particular regarding the framing of the budget, the expenditure of budgetted funds, and the appointment and promotion of the superior staff, but discipline and ordinary office routine, as well as such matters as the local administration of the Factories, Mines and Boiler Acts, should be left to the Director. Where the Board is in agreement with the Director, action may be taken within the powers delegated to the department by the Local Government; where they disagree, the matter should be referred to the authority to which the department is subordinate. It is hardly necessary to add that the Director should not submit proposals to Government regarding questions in which the Board is concerned, without consulting it.

Composition and strength of the Board.

309. Some diversity of opinion exists as to the composition and strength of the Board. We consider that it should be mainly non-official. We do not think that it should be used to co-ordinate the work of the various other departments of Government which will come into intimate contact with the Department of Industries, such as those controlled by the Director of Agriculture, the Registrar of Co-operative Societies, the Conservator of Forests and the Chief Engineer. In our opinion, the Board should be a link between merchants and manufacturers and the executive authorities of Government who deal with their interests. It is, we think, worth while to recommend specially that adequate provision should be made for the representation of financial interests by the managers of banks or branches of banks established in the province. The post of Secretary to the Board should be filled by an appropriate officer of the Department of Industries.

The Board should be a small body, the size of which should not be less than six or more than twelve, according to the province. In the case of a Board appointed from the business community of a province, it would hardly be possible to appoint more than a single member with a knowledge of a subject like hand-loom weaving; and such a member might not be helpful in respect of other matters. The Board should, therefore, have power to co-opt members for temporary or special purposes and to appoint standing or temporary sub-committees, including persons from outside its own number, to deal with special subjects. We think that the development of the department would be facilitated by the formation of local or district committees which would be able to diffuse industrial information and would report to the central committee regarding matters of local interest. Further these committees should prove a powerful means of exciting throughout the province an active interest in the work of the department.

Payment of members of the Board for attending meetings.

310. It might be desirable to offer fees to the members of the Board and of the sub-committees and to grant them travelling allowances for attending meetings. This course is commonly adopted, not only in the case of the directors of limited companies, but also of the members of Port and Improvement Trusts.

Qualifications of Director of Industries.

311. The description which we have given elsewhere, and in particular in Chapter XIV, of the duties which the Director will have to perform, and the proposals which we have made in this chapter regarding his administrative position and the working of his department, will show that he must be a man with special qualifications. These include, in the first place, business sense, *i.e.*, the capacity of appreciating the technical features of industries in their bearing on commercial possibilities, and the ability to form conclusions as to the commercial soundness of a scheme worked out by a technical expert; the power of organisation; familiarity with the practical handling of economic questions; and local knowledge. If such a man be also an expert in any industrial branch, this will be a great advantage. Men of the above type may be found either in Government service or among the commercial community. Officials will probably be somewhat deficient in their appreciation of the business aspect of

industrial propositions and in their capacity for business management. Those of them who do not possess technical knowledge will be unable to add to or improve the suggestions of their technical staff, and it is not likely that they will be able to initiate new industrial proposals. Non-officials may or may not possess expert technical knowledge; but they are less likely to have wide local knowledge, while the best men among them may not be willing to accept the comparatively limited prospects of Government service. Our remarks in this chapter have special reference to the initial appointments, which will give rise to the greatest difficulty. Later on, Directors will be provided from the Imperial Industrial Service, if our proposals in Chapter XXII be adopted. For the first appointments, power of organisation must be recognised as a factor of special importance. If, then, a properly qualified industrialist or business man is not forthcoming, the balance of advantage in these cases is in favour of the selection of the Director from one or other of the existing services. But no undue delay should be allowed to elapse before replacing a non-technical man by a suitable member of the Industrial Service.

Relations of Director with Local Government.

312. We recommend that the relations of the Director and the Local Government should be as direct as possible, an end which may be effected by giving him the position of Secretary for commercial and industrial subjects. Proposals emanating from his department will already have been scrutinised closely by the Board of Industries; and it seems an unnecessary addition to have these further passed under review by Secretaries with no special knowledge or experience of the subject, though they should of course be examined in the Financial Department of the Secretariat and by the Secretaries dealing with other departments which may be affected by the proposals.

We have considered the arguments put forward on the other side. Some of them have been recapitulated in a parallel case in paragraph 48 of the Report of the Public Works Department Reorganisation Committee. But with reference to the views therein expressed, we think that the Director of Industries and his Board, dealing as they do with the economic and business aspects of a proposal as well as with its technical features, will not be exposed to the risk of taking a narrow departmental point of view.

We recognise also that, as pointed out by the Public Works Department Reorganisation Committee, the head of a department, who is also a Secretary to Government, may be to some extent prevented from touring. But we think that this objection has been overstated. Although the touring work of the Director of Industries is important, it is confined to the area of a single province, and his tours need not, owing to the nature of his work, be so prolonged as those of a Chief Engineer. Cases can reach him by post and be returned by him without undue delay; and between his tours he will have ample opportunities for personal discussion with the Member in charge or the head of the Government. He would, in any case, require, except in the smaller provinces, the assistance of a Deputy Director, who should be an officer as far as possible of the type which we have indicated as required for the post of Director, and this assistance would set him free from routine inspections.

We have also seen it urged that the scrutiny of a proposal by the Member in charge (or the head of a local administration without a Council government) and by his Secretary should be looked on as a single administrative act, performed for the sake of convenience by two separate persons. In practice, however, this arrangement involves noting by the ministerial subordinates of the Secretariat and by Under Secretaries, with a consequent waste of time; and we are of opinion that, if the Director of Industries and the Advisory Board do their duty properly, the case can be put before the responsible head as adequately as by a Secretary; while in the cases that the Secretary at present sanctions on his own responsibility, the Director should himself have the necessary powers. A large proportion of the proposals sent up by him will be of a nature that should be decided on purely commercial principles; and, with the opinions of the Director and his Board to help him, the responsible Member of Government should have ample materials for coming to a decision. The cases referred should not be numerous, if proper delegation of powers is effected.

Salary of Director of Industries.

313. We have already drawn attention to the difficulties that will face a Local Government in selecting a suitable man to fill the post of Director, especially in the case of the first appointment; and these, together with the important influence which the personality of the Director will exercise over the tone and methods of the department, warrant a substantial rate of pay, sufficient to attract a good man and to retain his services for a reasonably long period. The Director, at least in all but the smallest provinces, should be a man with long Indian experience, which should probably not be less than 15 years. Such a man, if in the Indian Civil Service and of abilities above the average—and these will be needed in such a post—will be in receipt of not less than Rs. 2,000 a month. Members of the other services would be drawing somewhat lower pay. A man who has started in commercial life without family or other interest would at that time probably be a junior partner in a business house, with prospects of a largely increasing share in the concern. We have already stated that the Director of Industries should hold the full status of a Secretary to Government. These considerations seem to us to justify in the provinces of chief industrial importance, such as Bengal, Bombay and Madras, a salary of Rs. 3,000 a month, which might, in the case of a man taken from an existing Government service, be reached by incremental stages starting at a figure based on, but somewhat exceeding, his salary in the regular line, and graduated so as to reach the maximum in about 5 years. Further prospects in the imperial department also await a successful provincial Director. In the case of the less important provinces, the maximum salary might range between Rs. 2,000 and Rs. 2,500. We recognise that the nature of the work will vary greatly from province to province, and that the possible sources of recruitment will be numerous. We therefore think it undesirable to do more than indicate generally the limits of salary likely to be found suitable, leaving the Local Governments to work out their initial proposals to suit individual cases. To secure really outstanding men for the first appointments, it may prove necessary to give specially favourable terms, even in advance of those suggested above.

Salaries and duties of other officers of the Department of Industries; Deputy Directors.

314. A Deputy Director would be required at first in only the larger provinces; and he should receive a salary, which might suitably be incremental, beginning at Rs. 1,000 and rising to Rs. 1,500. Deputy Directors may, in the first instance, be recruited from Government services or from the commercial community, and later from the Imperial Industrial Service, as explained by us in the following chapter.

Industrial Engineers.

315. The industrial engineers who would be required in the provincial departments would be concerned mostly in the erection of small power plants and in advising on the erection of machinery in factories; specialist knowledge, where needed, would be provided, as a rule, by seconding special men from the cadre of the Industrial Service or by temporary appointments. They must be good all-round men with a wide range of practical experience. Men of the class required should be recruited in the first instance as explained by us in the next chapter, but they will need training and practical experience before they are fit to be placed on responsible work. As we point out there, the engineer staff should form the basis from which our proposed Industrial Service

will be built up, and for exceptionally qualified men there would be prospects of rising to administrative rank.

Chemists. 316. The work of Chemists in the provincial departments will be mainly of an analytical character, and men with adequate qualifications can be obtained on salaries of Rs. 300 rising to Rs. 500.

Circle Officers. 317. To carry on the current duties of the Department of Industries throughout the province, it would be necessary to create a number of territorial charges, the size of which would depend on the work to be performed. Each should be supervised by a circle officer, whose duties would comprise the general supervision of all but the most important local activities of the department. He would be its representative on the spot and the channel of communication between the people and the department. He would receive requests for assistance, make local inquiries, prepare schemes and supervise minor works. He should invariably be an engineer with a general experience of industrial work. Such appointments could be filled best by local men, who are more easily able to establish friendly relations with the people and can tour more freely among them. Their salaries should generally range between Rs. 200 and Rs. 700.

Intelligence work. 318. A senior office assistant on Rs. 500 or thereabouts would be required in all but the smallest provinces to collate and keep up to date the commercial and industrial information furnished to or collected by the Industrial Department, and to supervise the office work in connection with the checking of indents and the purchase and supply of stores.

Tabular statement of staff. 319. We give below a statement showing the officers who would constitute the superior staff of a Department of Industries in one of the larger provinces. Some of these would be officers drawn from the Industrial and Scientific Services, and the remainder would be either experts on temporary agreements, or officers recruited for the local Industrial Service, which each provincial department would require. The list is inclusive, and all the officers comprised therein might not be required in any one province at one time. We have formulated in the next chapter our proposals for the constitution of an Industrial Service, but, for the sake of convenience, we have anticipated these by indicating in the statement the officers who would ordinarily be members of that service.

Industrial Service.	Scientific Services.	Local Staff.		Special experts in
Director. Deputy Director. Industrial Engineers. Principals of colleges. Inspectors of Factories. Electric Inspectors. *Professors in technical colleges and schools.	*Professors in technical colleges and schools.	Circle officers. Superintendents of industrial schools, who will be qualified experts in the main industry taught in the school. Junior staff of technical colleges and schools. Inspectors of Boilers. Assistant Mechanical Engineers.	Supervisors (Erecting). Inspectors (Maintenance).	Tanning. Glass. Silk. Dyes. Oils. Metal working. Electro-plating. Pottery. Ceramics.

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* These will be sometimes engineers, sometimes industrial chemists, etc., and will act as experts and consultants in their special subjects.

CHAPTER XXII.

AN IMPERIAL DEPARTMENT OF INDUSTRIES.

Degree of responsibility attaching to the Imperial Government for the industrial policy of the country.

320. We have already explained that there will be certain industrial problems of importance common to more than one part of India, which in each case involve the employment of a comparatively numerous body of technical experts to investigate them, it may be on a commercial scale, and to propound promising solutions. These are sufficiently important and sufficiently correlated, both in themselves and in the public mind, to justify special treatment, and they involve interests which deserve separate representation in the Viceroy's Executive Council. They are more closely allied with manufacturing industries than with the production of raw materials, and we consequently see no reason for grouping them with Agriculture and Forests, which would thus remain, as now, associated with Irrigation, the administration of Land Revenue Law, the collection of Land Revenue and the control of the Veterinary Service.

It is thus a most important duty of the Government of India to provide the machinery required to ensure the uniform development that alone will make the country self-contained, both economically and for purposes of defence. From this point of view, India's most prominent present deficiencies are the absence of provision for the smelting of metals and consequent production of alloys, the manufacture of chemicals and the utilisation of the by-products of destructive distillation of coal and wood, the manufacture of rubber, now exported in a raw state, the preparation of foodstuffs for transport, the production of the better qualities of leather and the utilisation of the natural wealth of the forests for the recovery of drugs, essential oils and dyes. In addition to the production of these essential *materials*, the organisation on a large scale is also necessary of manufacturing operations for the production of *articles*, many of which will probably not be undertaken in the near future without some form of Government guarantee or support. This applies especially to the manufacture of electrical machinery and certain special forms of mechanical plant, such as internal combustion engines, machine tools, and heavy steel forgings. In most of these enterprises it is obvious that only Government can be expected to give an effectual lead. Similarly, propositions for the development of hydro-electric power involve concessions either for development or distribution independently of provincial boundaries and beyond the functions of Local Governments to regulate. We consider that our administrative proposals will meet these requirements without trespassing on the rights and functions of provincial Governments in connection with their own local problems, whether social, economic or industrial. In designing this central machinery, we are not in any way reducing the authority of Local Governments; for the programme of progress which we propose for them will, if conscientiously undertaken, demand a great increase of effort and of co-operation both on the part of the respective Governments and of the peoples under them. We are not taking away responsibilities from Local Governments in order to centralise them in the Government of India, but, on the contrary, are proposing additional activities for both, especially the latter, which, according to the majority of our witnesses, has been out of touch with the commercial and industrial needs of the country.

321. The duty of supervising and stimulating such important interests, many of which are vital both on economic and on military grounds, could not fairly be left to Local Governments, as the whole programme of industrial development must be framed on a national basis and, in particular, to meet military needs which will vary from year to year. Although some of these industries which are required for the direct production of lethal munitions will presumably be carried on in factories owned and administered by Government, by far the majority of them might more suitably be entrusted to private enterprise; but, if the latter are left to unassisted private enterprise, their development will be unequal, and only those will be taken up which offer the largest and quickest returns on comparatively small capital risks. Many of these industries also flourish only in family groups, and, unless the State is made responsible for the encouragement and maintenance of the economically weaker members of such groups, even the more remunerative enterprises may be neglected to the detriment and possible danger of the country. Experience of the past three years has drawn attention to the fact that the requirements of modern civil and especially industrial life largely coincide with the list of essential munitions of war, and that questions of defence are vitally connected with those of industrial development. After the war, India will find herself face to face with nations struggling to recreate their wealth and to emerge from the economic morass into which they have been plunged. All industrial problems will then assume an enormous importance for this country; and without wise guidance and the whole-hearted and energetic prosecution of a strong constructive policy, India cannot possibly become strong and self-supporting, and cannot possibly fulfil her duty to herself and to the Empire.

We have proposed in this report an extensive scheme designed not only to remove the existing industrial deficiencies that threaten national safety, but to strengthen and enrich the country as a whole, by providing it with the necessary equipment for increasing its powers of production. A necessity therefore exists for a central authority organised alike for the general control of this policy, and for the actual execution of such parts of it as we have shown cannot be suitably undertaken by Local Governments. No avoidable delay can be allowed to occur in the prosecution of this policy, and care must be taken that progress must be on even and continuous lines, and dangerous gaps avoided. These functions can only be performed by a special department of the Imperial Government.

Necessity for a Board of Industries.

322. The Imperial Department of Industries would control the administration of the various Acts with which it is concerned, and would be responsible for the general direction of the accepted industrial policy of the country, including technical and industrial education. The remaining duties of the department would consist of the initiation and running of any imperial pioneer and research factories that may be needed; the management of full-scale Government factories; the framing of schemes for assisting private enterprise of a class for which an imperial agency would be required; the supply of stores; the collection and dissemination of commercial and industrial information; and the direction of such scientific and technical services and departments as come under its control. The latter class of duties will involve much work of an executive nature, which cannot conveniently be performed directly by a department primarily constituted, like other departments of the Government of India, for the consideration and enunciation of matters of general policy.

An organisation of suitable constitution and powers will, therefore, be required for the performance of the administrative and executive duties described above. In view also of the growing complication of Government work, it is desirable to free the Member in charge from as much routine as possible, and leave him leisure to deal with questions of policy.

The executive and administrative duties of the department, many of which require special technical knowledge, should be performed in subordination to the member by a group of responsible officers whose experience and qualifications can be best utilised by combining them in a single body. This body we propose to call the Indian Industries Board. Its constitution and functions will be outlined after enumerating the various heads of work and subordinate departments for which the Member in charge would normally be responsible. They are obviously in excess of what any one individual could effectively control, while carrying on his duties as an Executive Member of the Viceroy's Council.

Relations between Member in charge and the Board.

323. We have, however, still to explain what, in our opinion, should be the precise relations between the Member in charge and the Board. We have considered the desirability of providing the Member with a secretariat and departmental establishment, in addition to the establishment attached to the Indian Industries Board. We recognise that the Member might with the help of a separate secretariat be able to bring a more independent judgment to bear on the Board's proposals. But the extra cost involved, and the delay and waste of work caused by the double noting, would more than outweigh the above advantages. The Member, after all, is responsible not only for laying down the general policy of the department, but for securing its energetic prosecution; and we think that this responsibility can be best maintained, not by placing him in the seat of a detached critic, but by emphasising his position as departmental head. He should, we think, be President of the Board, without the charge of any specific branch of work. This would enable him, in considering any question that may come before the Board or any proposal that may emanate from the head of a subordinate department, to take a view which would be free from the departmental prepossessions that may affect his colleagues. It will also keep the other members of the Board sufficiently in touch with the general policy of Government, to prevent inconvenient divergencies, resulting in friction or waste of work. The Member, as President of the Indian Industries Board, must have full powers as he has full responsibility, and should, therefore, be in a position to overrule the views of his colleagues; they should, however, have the right of placing their opinion on record in such cases.

Functions of Imperial Department of Industries.

324. The subjects and departments at present under the control of the Department of Commerce and Industry, which we have either specifically recommended for allotment to the proposed Department of Industries, or which should fall to its share, in view of their nature and associations, are the following :—

1. Geology and Minerals (including the Geological Survey of India and the administration of the Indian Mines Act).
2. Salt.
3. Indian Explosives Act and the Indian Petroleum Act.
4. Stationery and Printing.
5. Inventions and Designs.
6. The collection and distribution of commercial and industrial intelligence.
7. The supply of stores, which, under our proposals, will include the receipt of indents and their examination and distribution for

purchase in India or abroad; and the administration of the Department of Stores.

8. The Indian Factories Act.
9. The general encouragement of industries, including the grant of assistance or concessions to industrialists in cases of more than provincial importance.
10. Advice to Local Governments regarding the improvement of industries and the conduct of technical and industrial education, the latter of which duties has hitherto pertained mainly to the Department of Education.
11. The administration of the various Acts relating to steam boilers.

In respect of some of the above heads (Nos. 2, 6, 7, 9 and 10), we have proposed a considerable increase and modification in the scope of the existing work. In Chapter XV we have recommended that the following subject be transferred from the charge of the Public Works Department to the Department of Industries:—

12. Electricity.

We think that the Department of Industries should also be made responsible for the following heads, if they are placed under the control of a civil department:—

13. Ordnance factories.
14. The inspection of ordnance manufactures.

The proposals which we have detailed in Chapters IX and XIV of our report would also involve the control by the Department of Industries of the following entirely new heads:—

15. General direction and application of chemical research, and the control of the proposed Chemical Service.
16. Imperial factories for research or demonstration.

We have proposed that chemical research and the Chemical Service should be under the Department of Industries. Of the other scientific services recommended in Chapter IX, those relating to bacteriology, botany, entomology and zoology will be so closely in touch with the work of the Agricultural and Forest Departments that they would naturally come under the same department of the Government of India. The Chemical Service would, it is true, lend its officers to practically every department of the Government of India, but its relations with industries would be so numerous that it should certainly be brought for administrative purposes under the proposed Department of Industries. The subject of geology and minerals would also have its nearest associates in the chemical group. There remain a certain number of technical industries, such as tanning and the manufacture of glass and of certain chemicals, including dyes, which would require laboratories for research, research factories and small pioneer factories on a commercial scale. The staffs of these should include chemical technologists, and, as these factories would not be permanent, the cheapest way of staffing them would be to borrow men from the Indian Chemical Service.

With reference to items 13 and 14, ordnance factories and the inspection of ordnance manufactures, we have already stated in Chapter XIV that ordinarily we see no reason for the existence of full-scale Government factories, except for the production of lethal munitions. We have taken no evidence regarding the working and control of these factories, but we have contemplated the possibility of their being placed under the Department of Industries, because their operations must be conducted on business and technical lines very similar to other activities of that department. If it be decided to hand over these factories to the control of a civil department, they would naturally be administered with direct regard to military needs (and it should not be difficult to provide an appropriate mechanism in the form of a Munitions Council to ensure this end), while they would be actually managed by specialised technical officers.

We think that the Department of Statistics should be left under the control of the Commerce Department of the Government of India, while Fisheries should not be handed over to the Department of Industries, unless that department is also eventually required to take charge of Agriculture and Forests.

Duties and qualifications of members of the Indian Industries Board.

325. It will be observed that the heads of business which would be placed under the Department of Industries, fall naturally into three classes, with reference to their subject matter and to the qualifications required by the supervising member of the Board. The Indian Industries Board should, therefore, consist of three ordinary members apart from the President. The member dealing with heads 1, 2, 3, 15 and 16 should be a man whose education had combined a scientific training with subsequent practical experience in subjects such as those which form the equipment of, say, a consulting mining engineer or of a technological consultant. Heads 4, 6, 7, 8, 9 and 10 are matters into which general business qualifications mostly enter. It is important that the same member should be in control of heads 6 and 7 to secure close relations between the Controller-General of Stores and the Director of Commercial and Industrial Intelligence. Finally, heads 5, 11, 12, 13 and 14 are concerned either with actual commercial production or with the business aspects of industries, and could suitably be handled by an officer possessed of business experience, though his predominant qualification should ordinarily be a knowledge of engineering.

We consider it desirable that, if possible, one of the members of the Board should have had actual business experience.

The equipment of the three controlling officers, whose functions we have indicated, will thus cover almost all requirements in any branch of industrial development or administration, and we have already stated that we think it desirable to combine the three officers in a Board. When an officer is dealing with a proposal of importance, even where it relates exclusively to subjects under his own control, we think that personal discussion with experienced and highly qualified colleagues, whose charge consists of allied subjects, cannot fail to be of use. Discussion by the Board will be of special value in dealing with requests for concessions and for assistance to private industrial undertakings, and with proposals for the pioneering of new industries by Government; the disposal of such matters often involves very difficult questions, but these must be systematically examined and decided, if our proposed industrial policy is to be effective.

Salaries and responsibilities of the members.

326. The salaries of the regular members of the Board should be Rs. 4,000 a month each; their position and qualifications demand good pay, and that proposed would mark their difference in status from officers immediately subordinate to them, whose salaries would range from Rs. 2,000 to Rs. 3,000. The members of the Board should be appointed for a term of five years. To attract suitable commercial men who have proved their qualities in business, it may be necessary to offer a pension, and we consider that it would be advantageous to provide for a renewal of the period of membership in very special cases.

Each member should have power on his own responsibility to decide cases arising from the branches directly under him of less importance in point of principle or the amount of money involved; where other branches are concerned, a reference should be made to them ; but in more important matters it would be desirable to invoke the collective responsibility of the Board. The members of the Board should tour regularly and frequently; and their collective functions are not likely to be exercised with sufficient frequency to interfere with this duty.

Secretary to the Board.

327. The Board would require a Secretary, who should be Secretary to the Department as well as Secretary to the Board. He should draw a salary of Rs. 3,000 a month. An Assistant Secretary would also be needed for each of the three groups of subjects that forms the portfolio of each ordinary member of the Board.

Location of the Board.

328. After careful discussion of alternative plans we feel compelled to recommend that the headquarters of the Board should be with the Government of India. We have considered the possibility of separating the Member in charge from the rest of the Board, which would have made it possible to locate the latter body at some other centre. We fully realise from the unsatisfactory experience of the past, the imperative necessity of keeping the activities of the Board in close touch with the industrial life of the country. But we think that this need will be largely met by the fact that the officers controlling the various departments under it would be working in large industrial centres, while the members themselves also would have had considerable industrial experience and would tour regularly. It would, moreover, be difficult to select an industrial centre as the headquarters of the Board, without introducing a bias that might react unfavourably on other centres. Further, the importance of maintaining close contact between the Board and the Member in charge is very great. Without it the work of the Board would be delayed and tend to become ineffective, while the Member in charge of the Imperial Department might lose touch with the concrete facts on which the industrial policy of Government must be based; misunderstandings might arise, and the Board might lose sight of the wider aspects of policy by which its proceedings should be directed.

Necessity for a Financial Adviser.

329. To ensure that the proposed department follows sound financial methods and to save the delays which necessarily arise, if references to the Finance Department are conducted by ordinary departmental routine, we recommend that the services of a Financial Adviser, with similar powers and functions to those of the Financial Adviser to the Army Department, be made available for the Industries Board, as well as for the Department of Industries. His services would be of special value, if the Board be made responsible for the control of ordnance factories. This officer might conveniently be given a seat on the Board of Industries. This would secure for the Department of Industries a close understanding with the Department of Finance. The Financial Adviser need not be a full-time officer, but should represent the Finance Department, with powers to sanction expenditure within specified limits or to refer at his discretion proposals for expenditure to the Finance Department.

Organisation for carrying out the work of the department.

330. Our proposed organisation, both imperial and provincial, would require the services of a number of officers capable of exercising large administrative responsibilities of different kinds. It is clear, however, from the description of their duties given in the foregoing chapters, that the nature of

their work would in many cases require engineering experience and in almost all practical acquaintance with business methods. The difficulty which Government will experience in obtaining such men can only, we think, be overcome by training them in an Imperial Industrial Service, and we shall now outline the manner in which this service should be organised. We propose in the first instance to discuss the working of the scheme after the initial stages, and to deal later with the difficult question how it should be started and built up. The suggested imperial department would require suitable controlling and junior officers for work under the following heads :—

The administration of the Mines Act, which is carried out by the Department of Mines.

The Department of Northern India Salt Revenue, which will, if our proposals are accepted, be concerned almost entirely with the production of salt from sources under imperial management.

Inventions and Designs, the law and regulations regarding which are administered by the Controller of Patents.

The collection and distribution of commercial and industrial intelligence obtained from provincial and imperial officers by the Director.

The supply of stores, which will require officers under the Controller-General of Stores and the provincial Directors of Industries for purchase and inspection.

The Indian Factories Act, which is administered by provincial departments consisting of Chief Inspectors and Inspectors.

The general encouragement of industries, including the grant of assistance and concessions to industrialists.

Advice to Local Governments regarding the improvement of industries and the control of technical and industrial education.

The administration of the various Acts relating to steam boilers.

This head of work would be carried out in the same way as in the case of the Factories Act, by staffs under Local Governments.

Electricity. The Imperial Government has at present an Electrical Adviser, while the Local Governments have Electric Inspectors.

Government factories for research or administration. These would be worked by engineers, technical specialists and chemists.

The Controller-General of Stores would fix contracts for the supply of articles, among which engineering materials would be the most important. His staff would consist of purchasers and inspectors for textile goods, timber and furniture, tools, machinery and manufactured or partially manufactured metals.

The Director of Commercial and Industrial Intelligence would collect information regarding the prices, movements and availability of raw materials and manufactured articles, new industrial processes, and the progress of industries in India.

331. Provincial Directors would have a wide range of responsibilities. They would advise and assist local industries of all kinds in technical matters and would in many cases give direct financial aid. They would control industrial and technical education. They would collect industrial and commercial information, and would be the advisers of their Local Governments in industrial and commercial matters. They would arrange for the local

purchase and inspection of stores. They would have under them a staff including engineers, technological chemists, specialists in various industries, craftsmen, and technical and industrial teachers of various grades. The Deputy Directors would assist the Directors in most of these functions; and in particular would themselves inspect institutions for technical education. They would assist the smaller private industrial concerns, and supervise the work of engineers and industrial specialists. They would also organise and administer the various forms of assistance to cottage industries. The special Intelligence Officers at Bombay and Calcutta would collect and supply commercial and industrial intelligence in these cities, especially in respect of foreign trade.

Officers of the Imperial Industrial Service employed by Local Governments would be placed under their orders as in the existing cases of the Forest and Agricultural Services.

332. A number of engineers would, as we have seen, be employed under the higher administrative officers both imperial and provincial. Though the majority of these engineers might be engaged either on short-term agreements, or with salaries and prospects designed to retain them in Government service only for short periods, we think that some of the posts might serve as a useful training ground for higher administrative work.

A certain number of men with training in chemistry, geology, and specialised forms of engineering, such as mining (for example in the Salt Department) and electricity would also be needed.

Arguments for creating an Imperial Industrial Service.

333. A working basis for recruitment is thus indicated. It should not be difficult to select young men with a thorough training in engineering, but not yet definitely committed to any form of specialisation. If such men be recruited into a service with the duties and prospects of employment that we have described above, they would gradually acquire, in the less responsible departmental posts, business and administrative experience which would fit them for promotion to the higher grades. There would be some to whom the technique of their profession would make a stronger appeal, and these might prefer to specialise in different branches of engineering.

If, on the other hand, no such service be constituted, Government would be left with a number of isolated posts, each of which would have to be filled by separate recruitment or by casual promotion, and the result would be discontent or inefficiency on the part of the staff, and constant trouble to Government in filling vacancies. Government would find it difficult to obtain men of the qualifications required for the higher posts by direct recruitment; and would be in competition with private employers, who will themselves need just the type of men that Government is attempting to obtain. Unless, therefore, the prospects and prestige of Government service are such as to counterbalance the attractions of higher remuneration elsewhere, Government would have to be content with inferior men. The young engineer brought into Government employment may, under the scheme which we propose, reasonably count on promotion in due course to a post of Director, or of head of a department under the Industries Board; or, if his abilities are adequate, to a membership of the Indian Industries Board itself.

The parallel between these proposals and those for the scientific services is very close. In each case, we rely on the prospects of an organised service to facilitate recruitment by offering definite prospects and a continuous demand for men of a particular type, of whom a regular supply would be forthcoming in response thereto. The service would afford an elastic and convenient system of filling the various posts required throughout the country; and its existence and traditions should inspire *esprit de corps,* and give its members administrative experience and opportunities for specialisation. These qualities are expensive to buy ready-made in the open market. We do not, in the case of either the Industrial or the Scientific Services, overlook the necessity that will arise for the recruitment on special terms of men for individual appointments or lines of work, either from other Government services or from private employment, whilst outside consultants of high reputation will be needed from time to time to advise on specific problems.

It will be observed that the staff for the manufacture and inspection of munitions is not included in the above proposals. This staff will have to serve under special regulations, to secure the preservation of secrets of military value. The ordnance factories will be a unit sufficiently large to maintain a service of their own; but exchanges between this staff and the Imperial Industrial Service may occasionally be effected with advantage, and the latter would in any case provide a most useful reservoir for war purposes.

The Imperial Industrial Service.

334. Recruits for the Imperial Industrial Service should be men possessing qualifications such as will be obtained by mechanical engineers who have passed through the courses of training that we propose in Chapter X, or by students of the existing Indian engineering colleges who have obtained the full diploma in mechanical engineering. These qualifications are equivalent to, but not necessarily identical with, those required for admission as Associate Members of the Institute of Civil Engineers. The age of recruitment should not usually exceed 25 years. All recruits should be selected by a committee working under carefully prescribed rules. We think it desirable, if the young engineers whom we propose to recruit are to develope into valuable men, that they should be encouraged after about three years' service to take study leave, which should be given on not more than two occasions, and for not more than two subjects. The total leave so enjoyed should not exceed one year in all and should be confined to the first 20 years of service. Men within two years of their pension should not be allowed study leave. These conditions would, we think, give the best results and prevent abuses. They might also be made applicable to the scientific services.

The initial salary of men recruited under the conditions proposed above need not, on a pre-war basis, exceed Rs. 450 a month; they should be on two years' probation; and should be eligible on confirmation for appointment as Industrial Engineers in provincial Departments of Industries, in Government research or pioneering factories, or even, in exceptional cases, as Deputy Directors. These latter appointments, however, should as a rule be filled by men with not less than six years' experience of industrial work under Indian conditions. The pay of Industrial Engineers should be incremental, starting at Rs. 500 on confirmation and rising by stages of Rs. 50 a year to Rs. 1,500, with an efficiency bar at Rs. 1,250. More highly paid posts should in all cases be filled by selection.

The ordinary conditions governing the grant of pensions for Government service should be applicable.

Possible subsequent alteration in the nature of the work of the department.

335. We think it necessary to point out that the work which the Industrial Service would have to perform would eventually tend to change in nature. While it is impossible and useless to forecast the exact lines of alteration, the general trend, if the industrial policy which we recommend prove successful, will probably be in the direction of a lessened need for demonstration and pioneering work, and an increased necessity for research, technical education

and commercial and industrial organisation. The general characteristics of the staff employed would then become to a greater extent scientific and administrative, and to a less extent technical than at present contemplated. But the possibility of this change is relatively distant, and it is unnecessary to make proposals at this stage for any consequent change in recruitment.

Special temporary measures required.

336. To meet the situation which will exist before a regular Industrial Service has been built up, special measures will be needed. No time should be lost in introducing the proposed method of regular recruitment to fill the junior ranks of the service. But the selection of incumbents for the higher posts will be difficult, and there will be serious risks of failure and disappointment, the results of which are bound to retard progress. It is, therefore, necessary to move cautiously; posts should not be filled merely because such posts have been created, and permanent arrangements should not be made until satisfactory candidates are available. A policy of judicious opportunism must be adopted in respect of the sources of recruitment. Suitable men may be found in one or other of the existing services or in private employment. Though we think that engineering experience must even from the outset be regarded as a desirable basis, the capacity for organisation and general business sense will be of special importance in the case of initial appointments. Some indication of the lines on which we think that selection should be exercised in the case of Directors of Industries, which will be the most difficult of all posts to fill, has already been given in Chapter XXI. For these, and for other high posts, men may have to be engaged for limited periods and on special terms.

Necessity for training Indians.

337. We have already alluded in Chapter IX to the desirability of increasing the provision for training young Indians in the higher branches of science and technology, thereby increasing in the country the number of potential recruits for the proposed scientific and technical services. We have made similar proposals for the training of young engineers of the kind required for the suggested Imperial Industrial Service. We recognise that at the outset there will be some difficulty in obtaining recruits either from England, in consequence of the demands for qualified engineers for reconstruction after the war, or from India, because of the present relatively small field of selection.

As the opportunities for technical training increase, however, we believe that the necessity for importing specialists will diminish and that ultimately these services will be mainly filled with officers trained in this country.

CHAPTER XXIII.

ESTIMATE OF COSTS.

Scope and basis of estimate.

338. The proposals which we have made for the development of Indian industries involve the creation of an Imperial Department with an Industries Board exercising executive control over certain Government activities, some of which are already carried on and some of which are new; of provincial Departments of Industries, ten * in number, which will also take over certain duties from other departments, but will be mainly occupied with new work. We have prepared estimates showing the cost which the imperial and each of the provincial Governments would be called upon to bear. These estimates have been framed to provide for the work which, we think, may be done and the situation which, we think, will exist for some time after the end of the war; and we consider that the total proposed expenditure can be worked up to with advantage within a period of from five to seven years. A perusal of our report will show that we do not contemplate any extensive schemes of Government participation in actual manufacturing operations, and we provide no estimate of the cost of such Government factories as it may be found necessary to establish in the interests of national defence. Such expenditure would be incurred in pursuance of definite schemes of working prepared by expert agency, and only after their necessity has been accepted by Government.

Our proposals have in certain instances been framed only on general lines, and we have in some such cases suggested that expert committees be appointed to work out the necessary details. Moreover, the cost of experimental and demonstration work depends on the extent to which ideas likely to be useful to industrialists are evolved by the staff that we propose, and on the nature of these ideas. This can be determined only after detailed examination by that staff, based on some period of practical experience. The cost of construction and equipment of educational institutions and of industrial concerns is bound to be on a different basis under post-war conditions, and the salaries demanded by scientific and technical experts are also likely to be affected by the new economic position. Regarding all these items of cost we can be certain only of one thing, that they will be much higher than before the war, but how much this increase will be, and how it will be distributed, it is impossible to foresee at present. *We have, therefore, thought it better to adopt pre-war rates in all cases*, a method which has the advantage of giving a fairly certain basis, on which readjustments can be made as soon as the course of events makes this possible.

We have confined ourselves to (*a*) an estimate of the cost of the superior staff, establishments, and ordinary office contingencies required for the administrative organisations which we propose, (*b*) a rough estimate, based to some extent on the cost of existing institutions, of the initial and recurring expenditure on research and education, and (*c*) a general indication of the scale on which research and demonstration factories are likely to be conducted. We have not attempted to estimate the cost of office buildings for the staff of imperial or provincial Departments of Industries; in some cases accommodation is already in existence; in others buildings erected for war purposes may be made available; in others offices may be rented; local circumstances and probabilities which we have no means of ascertaining must be taken into account in each case.

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* *See* side headings in Statement I at the end of this chapter.

Some of our recommendations involve an increase in the cadres of the Agricultural and Forest Departments. These are in most cases either in support or in modification of proposals emanating from these departments, which have been referred to us for opinion, or placed before us in evidence. We do not feel it necessary to work out the detailed estimates for these proposals; this task can be more appropriately performed by the departments in question.

The Imperial Department of Industries.

The Member in charge, Rs. 90,700.

339. The charges on account of the Member would be :—

	Rs.
Salary of Member	80,000
Tour charges and travelling allowance	10,700
Total	90,700

The pay of a personal clerk, etc., would be found from the Board's establishment provision.

The Indian Industries Board, Rs. 3,96,700.

340. For the cost of the Industries Board no very useful precedent exists. The Indian Munitions Board, which is doing somewhat similar work, was started and continues under war conditions, and its functions in the purchase and control of supplies for large armies in the field naturally overshadow the rest of its work. The best basis to take is perhaps that of the Railway Board, whose work is doubtless greater in volume than that of the Industries Board would be, though it is probably less multifarious.

	Rs.	Rs.	
3 Members (Rs. 4,000)	1,44,000		
Secretary (Rs. 3,000)	36,000		
3 Assistant Secretaries (Rs. 1,000)	36,000		
Registrar (Rs. 800)	9,600		
Total	2,25,600	2,25,600	
Travelling allowance and tour charges of the Board	15,000	15,000	Estimated.
Establishment—			
3 Superintendents	21,600		One-half of Railway Board.
Clerical	97,500		
Total	1,19,100	1,19,100	
Allowances	16,500		Do.
Contingencies	19,500		Do.
Special charges	1,000		Estimated.
Total	37,000	37,000	
GRAND TOTAL		3,96,700	

The total of Rs. 3,96,700 compares with Rs. 6,12,000 for the Railway Board in 1913-14.

As against this charge, we anticipate the possibility of savings on the cost of the Department of Commerce and Industry, which the Department of

Industries should relieve of a substantial portion of its work. The expectation of savings is based on the work and establishment of the former department before the war, and without reference to any modification of these which post-war needs may entail; we do not attempt any precise calculation in figures. The total estimate for the Department of Industries amounts to Rs. 4,87,400, or, excluding the Member, Rs. 3,96,700, against a charge of Rs. 3,46,000 for the Department of Commerce and Industry in 1913-14. No special provision is included for the supervision of ordnance factories; we consider that the members of the Board should be able to perform this duty, if necessary, without addition to their number. We also think that a separate whole-time Financial Adviser will not be necessary, and have consequently not included his salary in these estimates.

Audit and accounts, Rs. 60,000.

341. The nature and extent of the agency required for audit, apart from the ordnance factories, depends very largely on the decision reached regarding the distribution of the purchasing organisation; for the expenditure on stores would constitute by far the greatest portion of audit work. With the degree of decentralisation which may reasonably be expected in respect of stores, the cost of the necessary audit establishment should not greatly exceed that of the establishment required in the case of Delhi, which amounted in 1913-14 to Rs. 45,848. We, therefore, estimate under this head a lump sum of Rs. 60,000. The total expenditure on the Member in charge, the Board, and on audit would thus amount to Rs. 5,47,400. The incidence of this charge, which may be looked on as the cost of general supervision and control on the total expenditure for executive work performed by provincial and imperial departments, is less than five per cent.

Subordinate Departments.

342. Of the 16 heads of business which would, according to our proposals in Chapter XXII, fall under the control of the Department of Industries, there would be no additional expenditure in respect of items 3 (Indian Explosives and Petroleum Acts), 4 (Stationery and Printing), 5 (Inventions and Designs), 8 (the Factories Act), and 11 (Steam Boilers).

Geology and Minerals, no addition.

343. Under head 1 (Geology and Minerals), we have suggested the appointment of a number of officers to inspect concessions of mineral rights belonging to Government. We understand that proposals have been made for an increase in the staff of the Geological Survey Department, which provide for a number of officers sufficient, we think, to enable the department to perform this duty, at any rate for the present; we, therefore, think it unnecessary to frame any formal estimate of the cost of our proposals.

Salt, Rs. 200 saving.

344. Under head 2 (Salt), we have suggested the desirability of handing over to Local Governments the work of prevention in connection with the extraction of saltpetre in the Punjab, the United Provinces, and Bihar; and of confining the work of the imperial department to the production and distribution of salt from the sources at present under its control. This would involve the appointment of technical officers to the charge of the department itself and of the different sources of salt; but, in view of the fact that Local Governments would probably arrange for the performance of salt preventive duties by amalgamating with their excise staffs such portions of the preventive establishment as might be handed over to them, we are unable to estimate the financial effect of this part of our proposals, though it should doubtless result in a saving.

Nor do we attempt any estimate of the lower establishment required for the actual extraction or production of salt, seeing that this would be increased or decreased according to the output which it is desired to obtain. For the superior supervising staff we estimate the following charges :—

	Rs.
Superintendent, Rs. 2,000	24,000
Manager at Khewra, Rs. 1,000—100—1,500 (1,333⅓)	16,000
Manager at Sambhar, Rs. 750 Manager at Pachbadra, Rs. 1,000	21,000
Manager at Kohat Manager at Warcha } Rs. 500 each	12,000
Chemist attached to the department for research and technical work, especially at Sambhar and Pachbadra, on an average pay of Rs. 1,000	12,000
Total	85,000

By relieving him of the duties of prevention, it should be possible to obtain a controlling officer, who may be styled Superintendent, on a salary of about Rs. 2,000. Under these conditions, the expert officers of the department should qualify for promotion to the post of Superintendent, which would require a general knowledge of salt extraction and administrative experience only.

Against this we have to set off the cost of the corresponding portion of the existing staff :—

	Rs.
Commissioner, Rs. 2,500	30,000
Deputy Commissioner, Rs. 1,200—40—1,400	16,000
Six Assistant Commissioners, of whom :	
One on Rs. 1,000	12,000
One on Rs. 900	10,800
and two on Rs. 500—30—800 will be replaced by the establishment above noted and the remaining two handed over with the preventive posts	16,400
	85,200

Nett decrease . . Rs. 200

This rearrangement of functions should result in a great improvement in the methods of mining and handling salt, and in the utilisation of by-products which are at present wasted, yielding, it may be anticipated, a greatly increased revenue to Government without additional expenditure on superior establishment.

Commercial and Industrial Intelligence, Rs. 61,500 additional.

345. Under head 6 (Commercial and industrial intelligence), we propose the following increases :—

Salaries—Director of Commercial and Industrial Intelligence, Rs. 2,500, against Rs. 2,000 at present. *Note* : Rs. 2,250—2,750 (or Rs. 2,750—3,250) was proposed by the Government of India in their despatch No. 168, dated the 7th July 1916	+6,000
Establishment	+12,000
Allowances to Trade Correspondents	+12,000
Contingencies (extra)	+6,000
	36,000

Our recommendations for the strengthening of the Indian Trade Commissioner's office in London involve (*a*) the appointment as Indian Trade Commissioner of an officer of the rank of a provincial Director of Industries, and (*b*) the deputation of three officers seconded respectively from the Agricultural and Forest Services and the Geological Survey. The salary which a Director of Industries would draw when serving in England may be calculated at the equivalent of Rs. 2,000 per mensem, or Rs. 24,000 per annum, as against £1,350, the present pay of the Indian Trade Commissioner. An increase of Rs. 4,000 must be provided on this account. The scientific officers would have about 10 years' service and would draw in India salaries of Rs. 1,000, Rs. 750, and Rs. 750, respectively. Under the ordinary rules, the salaries drawn in England by these officers would be approximately equivalent, at one shilling and four pence to the rupee, to Rs. 666, Rs. 500, and Rs. 500, or a total charge per annum of Rs. 20,000. To these must be added a charge for books and periodicals and office expenses of Rs. 1,500, or Rs. 25,500 in all. No extra provision need be made for the Assistant to the Commissioner or for increase of establishment. The total increase under this head, therefore, amounts to Rs. 61,500.

Stores, Rs. 8,56,000.

346. The system of purchase and inspection of stores which we propose would have to be applied, both to stores at present purchased in England but to be in future purchased in India, and to stores at present purchased in India, whether under a regular system of inspection as in the case of steel rails, or without any centralised or systematised organisation for purchase and inspection, as in the case of oils, paints, and textiles.

In preparing estimates of the cost of the organisation necessary for purchase and inspection we labour under the very great disadvantage of being unable to estimate, even approximately, the volume of business which will have to be transacted. The stores bought in England in 1913-14 were valued at just below £4,000,000, and the cost of the Stores Department of the India Office was £62,000, an incidence of 1·5 per cent. on the value of the purchases. The Stores Committee of 1906, for reasons stated in paragraphs 99 and 100 of their report, considered that the true incidence was at that time actually about 2 per cent., and a somewhat similar percentage would be reached were the same principles applied to the figures for 1913-14. It is impossible to forecast the extent to which Indian stores will in the future replace those now obtained from England; but it is certain to be very substantial. The Stores Committee was of opinion (paragraph 53) that articles valued at one-seventh of the total sum spent in England could have been obtained in India in the year 1904-05. Since then the manufacturing capacity of India has greatly increased, and an extensive range of new manufactures is likely to be started after the war. On the other hand, articles such as steel rails and cement, wholly or mainly purchased in England in 1904-05, are now obtained in India.

Figures do not exist to show the total purchase in India of stores by railways and military and civil departments of Government; but the sample figures given below for local purchases by railway store-keepers and by certain military departments will give some indication of their extent.

Stores purchased in India by certain railways in 1914-15, Rs. 1,41,00,000. In this year the purchases of rails and locally manufactured iron and steel articles were necessarily very small.

Purchases of clothing, leather articles, etc., by the Army Clothing Department in the year 1913-14 :—

	Rs.
Imported	11,49,000
Local	15,88,000

The above covers only a portion of the clothing requirements of the army in India.

Local expenditure on supply and maintenance of peace stores (other than food) by the Supply and Transport Corps in 1913-14, Rs. 17,53,000.

We have already indicated our opinion in Chapter XII that the precise allocation of purchasing and inspecting functions between the imperial and provincial agencies can only be made after an examination in some detail of the position in respect of each of the important classes of stores produced in India. To enable, however, an idea to be formed of the system that we propose, and of the incidence of its cost on that of the articles purchased, we have endeavoured to frame a provisional estimate of a centralised establishment which could do all that was needed, with the exception of small purchases which would be effected through the proposed provincial agency. This estimate covers the purchase of articles such as boots and textiles at present dealt with by military departments; but does not provide for the purchase of materials for ordnance factories. For the imperial Stores Department we propose the establishment detailed in Table A (para. 351). This department would receive all indents from departments directly under the Government of India and from Government railways; and would be prepared to assist other railways by arranging to include their requirements in running contracts, or by direct purchase on their behalf, if they desired it. It should also receive from the provincial Directors of Industries indents for the supply of stores which cannot be purchased locally with advantage. There should be a central office at Calcutta; and two stores depôts, for testing purposes, one in Calcutta, one in Bombay. The stores depôts would be for the receipt of miscellaneous goods which it may be necessary to examine and pass before they are issued to indenting officers; stocks should not be maintained at the depôts.

Purchasing staff (Stores).

347. The purchasing would be carried out by the following staff :—

A. One Deputy Controller, with three Assistant Controllers, dealing with the following groups :—

1. Electrical and mechanical appliances, hardware, implements and metals . . .	One Assistant Controller.
2. Railway materials	Two Assistant Controllers.

B. One Deputy Controller, with three Assistant Controllers, dealing with :—

1. Textiles	One Assistant Controller.
2. Leather and articles of leather . . .	One Assistant Controller.
3. Miscellaneous articles	One Assistant Controller.

C. One Deputy Controller, with one Assistant Controller, dealing with oils, paints, varnishes, and chemicals.

It should, however, be possible to effect a considerable degree of delegation to provincial departments, especially in respect of certain types of machinery and tools, textiles, miscellaneous articles, oils, and paints. The work of the above staff would consist mainly of fixing contracts; casual purchases could probably be best effected in most cases by the provincial Directors. In addition a Supervisor of Stores Contracts, who should unite business and legal experience, would be required, to ensure contracts being drawn in due form and containing the proper provisions needed to secure the interests of Government.

Inspecting staff (Stores).

348. The senior inspecting officers should each possess expert knowledge regarding a particular class of materials. In all we anticipate that 6 inspectors and 20 assistants will be required. This staff should be under a separate Deputy Controller (inspection), to ensure their independence of the purchasing branch.

Table A gives details as to the superior staff and clerical and subordinate establishment which, we think, it would be necessary to employ. It will be seen that the total estimated cost of the department amounts to Rs. 8,56,000.

The Testing House at Alipore.

349. Associated with this Stores Department would be the present Government Testing House at Alipore. It would necessarily require extension, both as regards personnel and laboratory accommodation. Fees are now charged for tests, and, if this system be continued, the Testing House and its establishment should be self-supporting.

Possibilities of decentralisation.

350. We assume that the Controller-General, in addition to his general supervising functions, would be responsible for the transmission to the India Office of all indents which cannot be complied with in India. We have provided for the equipment of the imperial Stores Department with a full staff of experts; but it will be for the committee whose appointment we have proposed to say to what extent the work of this department should be decentralised. As suggested in Chapter XII, the Controller-General of Stores should arrange for the centralised purchase of certain articles, such as the products of Indian iron and cement works, which require inspection by highly qualified experts; he might also make running contracts for the supply of classes of goods which are required on a large scale, such as certain kinds of textiles and oils, and the local Directors of Industries would make their purchases under these contracts. By this means, competition between provincial Governments would be avoided, and manufacturers would be placed in a more favourable position for dealing with Government orders. The provincial Departments of Industries would be equipped with a purchasing and inspecting staff capable of dealing with a fair proportion of the local engineering and miscellaneous manufactures.

The provincial Stores Departments would have to deal with indents, the value of which would be roughly proportional to the provincial revenues. The work of provincial Stores Departments would not be confined to the purchase of stores required locally. Excepting stores purchased by the Controller-General, all supplies required by provinces should be purchased by the stores agency of the province in which they are produced. The volume of business handled by these departments would, therefore, depend to some extent on the manufacturing capacity of the province.

Incidence of cost.

351. Our present estimate involves an annual cost of eight and a half lakhs of rupees and we think that purchases are not likely to fall short of 4½ crores, and may considerably exceed that figure. The resulting incidence is thus less than two per cent. and, though decentralisation, if efficiency is to be maintained, is bound to add to the cost of purchase, some increase is possible without raising the incidence to an unduly high figure.

TABLE A.

			Monthly. Rs.	Yearly. Rs.
		Controller-General (Rs. 2,750—3,000)	2,916⅔	
Purchase.	Engineering	Deputy Controller	1,750	
	Textiles	Ditto	1,500	
	Chemical Industries	Ditto	1,500	
	Inspection	Ditto	1,500	
Purchase.	Railway Materials (2) Textiles Chemicals and Oils Machinery Leather Miscellaneous	7 Assistant Controllers, Rs. 800—1,200 (Average 1,000).	7,000	
	Inspection	6 Inspectors, Rs. 800—1,200 (Average Rs. 1,000).	6,000	
		20 Assistant Inspectors, Rs. 450—700 (Average Rs. 600).	12,000	
		Supervisor of Stores Contracts	1,500	
		Total	35,666⅔	
		Travelling allowance	7,250	
			42,916⅔	
			(*Say* 43,000)	5,16,000
		Establishment		2,50,000
		Office rent, contingencies, and depôt expenses		90,000
		Total		8,56,000

Industrial Education, Rs. 99,200.

352. Under heads 9 and 10 (Encouragement of industries, advice to Local Governments, and industrial and technical education), the only expenditure incurred by the imperial department would be in respect of the staff of visiting experts, who would work directly under the appropriate member of the Industries Board. The allotment of work among these should be effected by one of them, who might be styled Senior Visitor. A small office staff, principally of tour clerks, would be required. The inspectors would be mainly concerned with industrial schools; the inspection on behalf of the imperial department of the higher institutions would be largely performed by members of the Industries Board and other high technical officers.

Salaries.

	Rs.	Rs.
6 Visitors, Rs. 1,000 average	72,000	
		72,000

Establishment.

	Rs.	Rs.
Clerks (including tour clerks)	10,000	
Servants	1,200	
		11,200
Allowances	12,000	12,000
Contingencies	4,000	4,000
Total		99,200

Imperial assistance to industrialists, which falls under head 9, would take the form of guarantees, loans, subscription of capital, special concessions of raw materials at low prices, or transport at favourable rates. It is impossible to form any idea of the probable amount likely to be chargeable under these heads. A large proportion of the outgoings should be recouped when the aided concerns are in full working.

Electricity: Hydrographic Surveys, Rs. 3,00,000.

353. Under head 12 (Electricity) the charges on account of the Electrical Adviser to Government would remain unaltered; but allowance should be made for the cost of hydrographic surveys.

The object of these surveys should be to determine definitely where sites exist for the generation of water power, either continuously throughout the year or with only a short period of intermission during the hot weather. It is not intended that each scheme should be worked out in detail; but merely that sufficient information should be gathered to enable a definite statement to be made as to the general possibilities of a site. The survey should be placed under a Public Works officer of the rank of Chief Engineer with a wide experience, which should include the construction of storage works and the administration of irrigation schemes. It would be necessary to associate with him an electrical adviser, and it is for consideration whether the Electrical Adviser to the Government of India could not perform this office. A certain amount of information of a not very definite character has already been collected by the Public Works Department; and this, we think, should be carefully scrutinised with a view to selecting areas and sites for the initial investigations. It is impossible to say what the result of these preliminary scrutinies will be; but it may be taken as certain that ten or a dozen proposals would be worth a personal visit on the part of the Chief Engineer and would possibly justify the formation of survey parties for further investigation. It is also desirable at an early date to enquire into the potentialities of power supply from the great irrigation canals of Northern India and the Periyar project in Madras. We may assume that it would be worth while to begin with surveys at ten or a dozen different places, and that as many survey parties would be needed. It is not possible to furnish any very accurate estimate of the cost of the work; but we assume that under the Chief Engineer two senior Executive Engineers would be required, and as many Assistant Engineers as there are parties established. We may take the cost of the Chief Engineer and his office establishment at Rs. 60,000 a year, the cost of the two senior Executive Engineers and their establishment at Rs. 40,000 a year, and the cost of each survey party at Rs. 15,000 a year, or Rs. 1,50,000 for ten parties. A lump sum provision of Rs. 50,000 is also necessary for the establishment of gauging stations to measure the flow of water in streams, and rain gauges to determine the amount of rainfall in the catchment basins, which will be mainly in places distant from established meteorological stations. It is probable that sufficient work would be found to keep this establishment for a period of about five years, making the total cost of this preliminary hydrographic survey about 15 lakhs of rupees.

Ordnance factories and inspection of ordnance manufactures.

354. We do not frame any estimates under heads 13 (Ordnance factories) and 14 (Inspection of ordnance manufactures).

Chemical research, Rs. 5,00,000.

355. Head 15 relates to chemical research, and includes the Indian Chemical Service. The cost of a portion of this service has been taken against the various heads in which these officers will be employed. The scheme, however, must be at present regarded merely as a general proposal, until it has been examined by the committee which we have proposed in paragraph 123 of

Chapter IX, and we have, therefore, not framed estimates to cover the whole of the scheme, though for the sake of convenience we indicate the probable cost of the nucleus administrative staff and laboratory. The increased cost in salaries for the service generally has been roughly foreshadowed in our report as about nine lakhs of rupees.

We estimate the cost of the nucleus establishment on the following basis. We may assume that the superior staff detailed below can be advantageously employed :—

	Rs.
Chief Chemist, Rs. 3,000	36,000
8 Chemists (of whom two will probably be physical chemists) on average pay of Rs. 1,000	96,000

Allowance must also be made for the cost of salaried research students and of men brought in from time to time for special work from the Chemical Service. The recurring cost of the Pusa Institute, with nine specialists and with an expensive farming estate to keep up, is approximately Rs. 5,12,000 ; that at Bangalore, with five specialists, is about Rs. 2,60,000. A total annual allotment of Rs. 5,00,000 should cover the recurring cost of the imperial laboratory and nucleus staff, with all incidental charges.

Our proposals also contemplate the appointment of three Deputy Chief Chemists, who would be located at different centres of specialised chemical research, one or more of which might be existing research institutes, as may be determined later. The cost of these officers is not, however, provided in this estimate, as this and other details of our scheme are dependent on the conclusions of the proposed committee.

Imperial factories for research and demonstration, Rs. 1,00,000.

356. In paragraph 364 of this chapter we make provision for experiments and research which will include the running of pioneer and demonstration factories under provincial Departments of Industries, such as, possibly, silk filatures and sugar or *gur* plants. The great bulk of the work under this head would be of provincial interest, but there would also be a few cases in which the results would be of much wider value and the expenditure and difficulties involved often proportionately greater, and these, we think, should be undertaken under the control and at the cost of the imperial department. As instances of experimental factories which could be more appropriately started by imperial agency may be cited (*a*) glass works, on account of the wide range of experts needed, and (*b*) wood distillation, which would yield results of very general application, and should be applied to a number of different species of trees. It would be for the Industries Board to decide on the best site for the factory in each case and to determine the exact object of the experiment, which should be placed in charge of a suitable specialist. In some cases it would be possible, when the original scheme had been approved by the Board, to place such a factory under the general supervision of the local Director of Industries, but in others, especially where the raw products dealt with are the property of a department like the Forest Department, it would be necessary to retain it under imperial control, which would be exercised by a member of the Board. Apart from initial capital outlay, which can only be estimated when the individual scheme is worked out, and would generally be recoverable before the experiment is concluded, we think that the average nett annual cost should not be more than Rs. one lakh, though the budget provision for expenditure would of course far exceed this figure. We anticipate that the products manufactured would usually more than cover the running expenses,

exclusive of the special staff and establishment which the experimental nature of the work would involve.

Provincial Departments of Industries.

Heads of expenditure.

357. The expenditure of provincial departments would fall mainly under the following heads :—

(1) Administration and control.
(2) Education.
(3) Experiments and demonstrations.
(4) Professional advice and assistance to local industries.
(5) Grants of loans, and supervision and inspection of rural industries.
(6) The inspection of factories and steam boilers.
(7) Collection of intelligence.
(8) Purchase of stores.

Under most of these heads, the previous experience available as a guide in framing our estimates is somewhat scanty. We may, however, now proceed to examine such as there is, and to draw therefrom such conclusions as seem practical.

Administration and control. Rs. 13,66,200.

358. The administration of provincial Departments of Industries should be in the hands of officers of the Imperial Industrial Service, and in each province there should be a Director of Industries, assisted in the larger provinces by a Deputy Director. The services of industrial engineers will also be required, who would conveniently be employed in territorial charges. In these charges they would carry out many of the duties which we have assigned to Deputy Directors generally, besides advising and assisting owners of industrial plant, and administering the distribution of loans. In addition, staff may be required, as we have already indicated, for the purchase and inspection of stores. In Bengal and Bombay there should also be two special Commercial Intelligence Officers of the rank of Deputy Directors. Chemists who would be members of the Indian Chemical Service would also be required for one or two provinces which will not have technological institutes at the outset. The salaries which these officers should draw in each province would usually be those which they would receive as members of the services to which they belong, and the probable average figures are exhibited in Statement I at the end of the chapter, from which it will be seen that the total annual cost amounts to Rs. 13,66,200. We have also proposed that the staff employed for the administration of the Electricity, Factories, and Boilers Acts should be transferred to the Departments of Industries, and only in the case of the Electric Inspectors, for reasons given in Chapter XV, do we propose any additional expenditure. For these latter, we consider that a pay of Rs. 1,000 or Rs. 1,200 would be sufficient in the provinces where electrical installations are fewer in number. For the Electric Inspectors of Bengal and Bihar and Orissa, we propose salaries of Rs. 1,500 in view of the growing developments in the coal fields ; while the special importance which electricity is assuming in Bombay will, we consider, necessitate a salary of Rs. 2,000 to secure an officer of first-rate abilities. The cost of the necessary subordinate establishment has been calculated for one or two provinces, and approximates to two-thirds of the pay of the officers employed. This basis has been adopted throughout, but we have thought it advisable to distinguish between the technical subordinate establishment, which would include the staff of the headquarters' laboratories and

workshops, and the clerical and administrative staff. The superior staff of the larger provinces would, as we have said, include industrial engineers who would be assigned territorial charges; but, ultimately, as the subordinate territorial agency of circle officers becomes more efficient, we anticipate that some degree of specialisation will be found desirable; and it may, for instance, prove convenient, while retaining at headquarters a single officer as Deputy Director who would assist the Director and would deal particularly with economic and business questions and commercial intelligence, to hand over the work in connection with organised industries to a second officer who would be pre-eminently a mechanical engineer; and to entrust the administration of loans to a third officer with engineering knowledge, who would have acquired special experience in dealing with rural and cottage industries.

Technical and industrial education, Rs. 1,42,00,000 capital expenditure, Rs. 62,00,000 recurring (of which Rs. 35,00,000 will be new), *vide* **paragraph 375.**

359. The statistical returns furnished to the Educational Commissioner show that in 1916-17 the total expenditure in India on technical and industrial education was Rs. 27,17,913, made up as follows :—

TABLE B.

——	* Expenditure.	Number of students.	Cost per student.
	Rs.		Rs.
Engineering Colleges	8,26,731	1,319	626
Schools of Art	2,81,391	1,695	166
Engineering and Surveying Schools	3,02,694	874	346
Technical and Industrial Schools	13,07,097	10,037	130
Total	27,17,913		

* NOTE.—To simplify the figures, the small expenditure on female education, almost entirely in industrial schools is omitted from consideration throughout.

The average cost per student in Table B requires a more detailed analysis before any deductions can be drawn therefrom. This we now proceed to furnish in Table C, which gives details regarding the four engineering colleges under Government management.

TABLE C.

——	Cost.	Number of students.	Cost per student.
	Rs.		Rs.
Madras	1,45,296	511	284
Poona	1,12,792	220	512
Sibpur	2,33,795	284	528
Roorkee	3,34,848	304	1,101
Total	8,26,731		

From Table C it will be seen that the cost per student varies from Rs. 284 at Madras to Rs. 1,101 at Roorkee. The explanation for this great difference is that in Madras the students are non-resident and most of them are studying for subordinate grades, whilst at Roorkee the students are resident and a much larger percentage of them have in view the higher branches of the services.

So far as is practicable, we have examined the budgets of the technical or technological institutions which already exist, few of which, however, provide as high a class of training as we contemplate should be given in the future. As a typical example, we might cite the Agricultural College at Coimbatore, the budget allotments for which, in 1918-19, amount to Rs. 1,27,553. This college provides for the training of from 100 to 120 resident students. Besides teaching work, the staff also carries on a considerable amount of research, and manages an experimental and demonstration farm which yields produce worth Rs. 25,000 per annum. The nett cost per student is, therefore, under Rs. 1,000 per annum. An examination which we have made of the cost of an engineering and technological institute on the lines which we propose has led to somewhat similar results. In our estimates for technical and technological training we have assumed that the average cost of training would be about Rs. 1,000 per student per annum. This, we think, is an inclusive figure.

We have drawn attention to the urgent necessity for the training of mechanical engineers; and we are indebted to the East Indian Railway Company for a detailed estimate (see Appendix N) for a school of engineering at Jamalpur, on the lines we have proposed. The establishment of this school would involve a capital outlay of Rs. 2,75,000 and recurring charges of Rs. 1,50,000, and is intended to provide accommodation for 160 students. This estimate of capital expenditure allows for existing hostel accommodation for 90 apprentices, costing Rs. 90,000; and this amount should be added to arrive at the total cost of establishing a school on the lines worked out by the engineering authorities of the East Indian Railway. The conditions at Jamalpur are somewhat exceptional, as the proportion of European apprentices is unusually large. We have prepared an estimate for an engineering school associated with a large engineering establishment, in which all the apprentices would be Indians, and we find that the capital outlay required on a basis of 200 apprentices works out at about Rs. 2,000 per head, and the average cost per annum at Rs. 570 per head. Considering that more than half the training of the apprentices is given in the workshops, the cost is very high; but this is due to the fact that we consider it necessary at the present time to offer special inducements to attract a sufficient number of educated Indians as apprentices. These inducements take the form of free board and lodging in addition to the wages which they will earn; but we anticipate that, as the prospects which will be open to this class of student become better appreciated, the necessity for free board and lodging will gradually disappear; and that in the meantime public bodies and individuals will offer scholarships to provide for students in excess of the number estimated. The artisan apprentices would also receive elementary technical instruction in the engineering school which we propose, but we do not consider that this will involve extra expenditure on buildings, equipment, or staff.

360. In regard to the capital cost of new colleges and institutes, we have not been able to obtain figures on which a reliable estimate can be based. The College of Engineering in Madras is in course of transfer to a new building; the sanctioned estimates amount to Rs. 17,75,000, and, allowing for the value of the plant and apparatus transferred from the existing college, we may assume

that the capital value of the new college will be Rs. 20,00,000. It will provide accommodation for 500 residential students. The majority of these, however, belongs to the upper subordinate and subordinate classes, and it is fair to assume that the accommodation provided for the staff and the equipment of the laboratories and workshops would have to be on a somewhat larger scale if all the students belonged to the advanced classes.. Students of technology would, however, be of various grades, and, while the capital outlay for the highest grade would certainly be not less than Rs. 6,000 per head, the average for all classes would probably not exceed Rs. 4,000.

We have been furnished by the Director of the Indian Institute of Science with a very detailed analysis of the capital expenditure incurred on that institution. The total amounts to Rs. 23,50,000. At the very outside it is capable of providing accommodation for 100 research or advanced students. The expenditure in this case has been on a lavish scale and, making allowance for this, the capital outlay per research student need not have exceeded Rs. 20,000. Beside the educational returns on this expenditure in the shape of trained research workers, the commercial value of the research results must also be considered, for it exceeds the total capital outlay on this institute.

361. It now becomes necessary to frame some estimate of the number of students for whom higher education in engineering and technology should be provided. The Department of Statistics has furnished us with a return of the number of large industrial establishments in India, and of the number of persons employed in them. The number of establishments is 4,053 and of persons employed 1,135,147. The figures relate to the year 1915 and do not include any returns from the mines. We have not been able to make use of these figures, and we present them merely to afford some indication of the scale of manufacturing operations at the outbreak of war. But, with these figures before us, we think it will not be deemed excessive to provide for an annual outturn of 400 trained technologists and 400 mechanical engineers, capable ultimately either of becoming foremen, or of occupying positions superior to those of foremen. Taking the average length of the courses for technological students as three years, there would be 1,200 under training at any one time. The capital outlay involved would be about Rs. 50 lakhs, out of which, after assessing the valuation of existing facilities, Rs. 40 lakhs may be taken as new expenditure, and the annual expenditure would be Rs. 12 lakhs, to which must be added about Rs. 7 lakhs * for the training of the civil engineering students. The course for mechanical engineers will usually not be less than five years, which involves a provision for 2,000 apprentices at a cost of Rs. 40 lakhs initial charges and Rs. 11,40,000 recurring.

The cost of improving the existing system of mining education, as estimated by the Macpherson Committee, was as under :—

	Rs.
School of Mines—	
Initial	5,56,000
Recurring	98,000
Evening classes—	
Initial	1,51,000
Recurring	71,000

We accept these figures for the purposes of this estimate.

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* Out of Rs. 8,26,731 shown in Table C about Rs. 7 lakhs may be taken as the expenditure exclusively on civil engineering.

362. We may now proceed to consider the cost of training students of a lower grade. The returns of the Educational Commissioner for 1916-17 throw some light on this; but as the work has been done hitherto in a very unsatisfactory way, it is evident that a much larger expenditure will have to be incurred in future than in the past.

TABLE D.

——	Government.	Local Fund and Municipalities.	Private aided.	Private unaided.
Schools of Art	5	...	1	3
Engineering and Surveying Schools	9	...	7	3
Technical and Industrial Schools	38	41	85	17

Table D furnishes details regarding the number of schools of art, of engineering and surveying schools, and of technical and industrial schools at present in the country. Some are managed by Government, some by local funds and municipalities, and some by private agency, and the last-named are divided into those which receive grants-in-aid and those which do not. The unaided schools may be omitted from consideration, as the usual reason for their non-receipt of Government aid is that they are not classified as eligible. The five Government Schools of Art train 1,310 pupils at a cost of Rs. 2,61,314, which works out almost exactly to Rs. 200 per head. The Government technical and industrial schools, which are really all industrial schools, are 38 in number and train 2,431 students at an average cost of Rs. 160 per head. Those under private management aided by Government are 85 in number and train over 4,000 students at an average total cost of Rs. 177 per head. These are mainly mission schools.

These average figures are not of much value, as they relate to institutions of very different merit. In all these schools some part of the receipts is derived from the sale-proceeds of work done in the school by the pupils, and in the better-managed schools this is an important source of income. Taking this into account, we think that industrial schools can be run at an average cost per pupil of Rs. 200 per annum, and that they can be established with a capital outlay of Rs. 500 per student. Ordinarily, schools should not train more than 100 pupils at a time. The average attendance at present is very much less than this, but only a few of these institutions are under competent superintendents with a trained staff of teachers. Our estimates provide for the ultimate establishment of 150 such schools, affording accommodation for 15,000 pupils and involving a capital outlay of Rs. 75,00,000 and annual recurring charges of Rs. 30,00,000. The whole of this expenditure should not fall upon provincial revenues, although it figures in Statement II as a provincial charge. As these are institutions which would be entirely devoted to the improvement of cottage industries, and would be almost entirely of local interest, the bulkof them, therefore, should be controlled and supported by local bodies or by private agencies, and be assisted by Government only through grants-in-aid. For purposes of administration the schools would be grouped territorially under the Deputy Directors, who would doubtless avail themselves of the services of the expert head masters of the higher-grade Government schools in matters connected with the detailed working of the smaller schools.

363. It would also, however, be necessary to appoint thoroughly qualified visiting experts for industrial schools, and these have been included in the cadre of the imperial department. The majority of industrial schools can be grouped as metal-working, textile, and wood-working schools, a division which would require three experts for each province as inspectors; but it is fairly certain that no one province would be able to find full-time employment for so many men. The inspection of these schools, and the control of those which are either directly under Government or under local bodies, should, we think, be provided as follows. The Government schools should, as we have already proposed in paragraph 143, be under the charge of one or more skilled industrial teachers, who would be primarily responsible for their efficiency. The advantages of sharing in this arrangement would be also open to industrial schools under local bodies. This would save expense in the first instance, and admit of some reduction on the estimate we have framed. Later, as funds were available and skilled teaching staff was trained, each school might be self-contained. The ultimate responsibility for these schools would naturally lie with the Director of Industries, who would regularly inspect them with the help of his superior staff. We have, however, pointed out the divergencies of method, and the general inefficiency of these schools, and have drawn attention to the necessity of securing a better appreciation of the most promising methods of working. We are, therefore, of opinion that the inspection work should be done by imperial officers who should, in all cases, however, report to the Local Government responsible for the schools inspected. It is highly important, in the matter of inspection, that the charges of the officers responsible for this work should be allotted by subjects, rather than on a merely territorial basis. They should be able to advise in regard to the instructional courses, the manufacturing processes, and the commercial disposal of the goods manufactured. Cottage industries are of enormous importance in India, and, if they are not only to hold their own, but to make real progress, they must be assisted by the best experts obtainable. We doubt whether an officer can effectively inspect more than 25 schools scattered through India, and, on the assumption that ultimately there will be 150 industrial schools, about six visiting experts would be required (see para. 352).

Experiments and demonstrations, Rs. 6,50,000.

364. In the aggregate a great deal of money has been spent in the past upon experiments and demonstrations; but little or no information is available regarding the conditions under which these were carried on, and this expenditure consequently affords no useful basis for future estimates. In the Memorandum on the Department of Industries in the Madras Presidency, Appendix J, we find that the experimental manufacture of aluminium ware was carried on for six years and resulted in a nett profit of Rs. 30,000; while chrome-leather experiments extended over seven years and cost in all Rs. 55,000. Similarly, in regard to weaving, Rs. 85,000 was the nett expenditure in 15 years. These figures show that a great deal of work can be done for comparatively little money; but, on the other hand, pumping and boring operations in 11 years have cost Rs. 6,80,000, and the budget estimates for 1917-18 provide for an expenditure of Rs. 1,48,000. Against this charge, a sum of Rs. 35,000 in receipts from fees is estimated. We find that in the budget of the Madras Department of Industries for 1917-18 a provision of Rs. 1,18,000 is made for industrial experiments, and that, in the Agricultural Department's budget, the sugarcane breeding station at Coimbatore is estimated to cost Rs. 42,000 a year. Excluding such experiments and demonstrations as may properly fall within the purview of the

imperial department, we have come to the conclusion that under this head the following provisions should be made for the provincial departments:—

	Rs.
Madras	1,00,000 each.
Bombay	
Bengal	
United Provinces	
Burma	50,000 each.
Punjab	
Central Provinces	
Bihar and Orissa	
Assam	25,000 each.
North-West Frontier Province	

These sums do not include the salaries of the officers who would control such work, which would be borne on the provincial establishments.

Professional advice and assistance to local industries.

365. The work of giving advice and assistance to local industries will form part of the duties of the Director of Industries and his staff and should involve no expenditure beyond that provided under the head of "Administration and control"; in fact, under this head, there should be a gradually increasing income, as only in backward tracts should such work be undertaken without fees. We have seen that such fees are already levied in the Madras Presidency, and we gather that they have not proved deterrent to industrial progress, while they prevent much waste of time in dealing with futile applications. The Madras rules, as sanctioned in Government Order No. 856, dated August 10th, 1916, will illustrate the lines on which it has been found possible to work such a system.

Grant of loans and the supervision and inspection of rural industries, Rs. 12,72,000.

366. In Chapter XX we recommend the grant of advances and hire-purchase loans on the lines that have been experimentally followed in Madras and Mysore, and we estimate that, when the provincial Departments of Industries are fully equipped, advances to the extent of about a crore of rupees a year might be taken with good results. The whole of this money would be spent on the equipment of cottage industries and the establishment of comparatively small factories, or of power plant mainly engaged either in lifting water for irrigation or in the preparation of local raw produce, largely agricultural. The administration of these loans would necessitate the examination of the security tendered by the applicants, and the consideration of their capacity to carry on the work that they propose to take up. In almost every case it would also involve a very careful scrutiny of the conditions affecting the success of the enterprise. Where loans are granted, it will almost inevitably follow that plans and estimates will have to be prepared, the machinery purchased and erected, the staff to work it trained and, finally, the plant handed over in good working order. To perform these duties we have proposed, under the head "Administration and control", the appointment of Deputy Directors with experience in mechanical engineering, and they should be assisted by a sufficient subordinate engineering establishment, most of which would be organised in territorial charges. We think that at first the enquiries into titles and encumbrances of landed property might be conducted by the local revenue staff; later on, if the work increases largely, special arrangements may prove necessary. For a major province making advances which would average about 10 lakhs of rupees a year, and be recoverable within a period of six years, the maximum outstandings would amount to 60 lakhs of rupees which, at 6¼ per cent. interest, would yield a

revenue of Rs. 3,75,000. As the rate for *takavi* loans was fixed when the conditions under which the Government of India could borrow money were very different from those now existing it would be necessary to consider whether the interest chargeable should not be raised to a figure which would render this important branch of the work more or less self-supporting. In some at least of the major provinces we anticipate that employment may be found within five years for about 15 circle officers in each, who with their establishments would cost on an average Rs. 1,000 a month each. Roughly, it may be assumed that at least one-third of their work would be connected with the disbursing of loans and the carrying out of hire-purchase agreements; and, on this assumption, and taking the cost of supervision and establishment into account, there would be chargeable against the loans account in such a province, as the cost of administration, about Rs. 80,000 a year. If, for example, money can be borrowed at 5½ per cent. interest, the charges would amount to Rs. 3,30,000, and the cost of administration to Rs. 80,000, making a total of Rs. 4,10,000, which would be covered by a rate of interest on the loans of 7 per cent. It would not press unduly on borrowers if 7½ per cent. were charged to allow a margin for contingencies. This should not prove at all a heavy burden, as experience has shown that the economic results of such loans, when properly expended, are very striking, and not a few instances have occurred in which the whole capital outlay has been recouped within one or two years. It should be the policy of the Departments of Industries to make the work of supervision and inspection as far as possible self-supporting. Efforts should be also made to encourage the establishment of rural engineering factories capable of taking over the work which, in the first instance, would have to be done under the supervision of circle officers; the facilities which we have proposed for training mechanical engineers would help to render this possible.

Inspection of factories and steam boilers.

367. From the Budget Estimates of 1917-18 the following tabular statement has been prepared showing the expenditure on the inspection of factories and steam boilers.

——	Factories.	Boilers.
	Rs.	Rs.
Bombay	69,000	92,000
Bengal	62,000	...
Madras	32,200	32,100
Burma	17,300	...
United Provinces	16,700	25,200
The Punjab	13,600	14,900
Central Provinces	...	25,600
Bihar and Orissa	700	...
Assam	...	...
TOTAL	2,11,500	1,89,800

We have no additions or alterations to suggest under these heads.

368. The collection of commercial and industrial intelligence would be effected by the various members of the departmental staff in the course of their ordinary work. The territorial organisation of the staff would no doubt render this easier. A compiling and recording agency would be required, which is included in our estimate of the Director's office charges. In the case of Bombay and Calcutta, we have recommended the appointment of special provincial officers for commercial and industrial intelligence; their salaries, in consideration of the work which the commercial importance of these cities would entail, should be Rs. 1,500 a month.

Collection of commercial and industrial intelligence, Rs. 36,000.

369. The share of the cost shown in the present estimate under the head, Stores (Imperial), which would ultimately be made over to provincial departments, would depend on the decision reached as a result of the special enquiry which we have already suggested.

Purchase of stores.

Capital Expenditure—(a) Recommended Schemes.

Under the head of capital expenditure it is possible to furnish only a rough estimate based upon the figures which we have obtained regarding the cost of buildings and equipment of existing institutions, and upon the immediate needs of the provinces, so far as we can estimate these.

370. We have already stated that we think provision should be made for training 15,000 pupils, and that the average cost of the industrial schools and their equipment will be Rs. 500 per pupil. This involves a total expenditure of Rs. 75 lakhs, from which must be deducted the value of such existing institutions as may prove suitable. From Table D it will be seen that there are at the present time 181 schools owned as follows:—

Industrial schools, Rs. 55,00,000.

Owner.	No.	No. of pupils.
Government	38	2,431
Local Funds and Municipalities	41	2,998
Private bodies receiving grants-in-aid	85	4,092
Private bodies not receiving grants-in-aid	17	516
TOTAL	181	10,037

Some of these may disappear, others may be greatly modified, and new schools may be started. It would not be safe to reckon that more than Rs. 20 lakhs can be taken as the value of buildings that would be of use under our proposed scheme; and the nett cost would be, therefore, Rs. 55 lakhs.

371. The following tabular statement shows the amounts which we think should be provided for each province for technological institutes:—

Technological institutes, Rs. 47,00,000.

	Lakhs.
Burma	8
Bihar and Orissa	13
United Provinces	6
Bengal	10
Madras	5
Bombay	5

At present, beyond the school of engineering at Insein, no provision has been made for technical education in Burma. A technological institute is needed in or near Rangoon which should at the outset provide accommodation for about 100 students. The capital outlay per head would be considerably above the average rates shown in paragraph 360 in view of the high cost of materials in Burma and of the fact that the institute would be at first on a limited scale. We have, therefore, proposed a total expenditure of Rs. eight lakhs.

Technological institutes would be required for Bihar and Orissa and for the United Provinces, which might be at Bankipore and Cawnpore, respectively; for each of these an initial outlay of Rs. six lakhs should be sufficient. The former province would also require a school of mines at Dhanbaid and improved accommodation for evening classes on the coal fields costing in all Rs. 7,07,000, or (say) seven lakhs of rupees.

Bengal has at present only the Sibpur College of Engineering; chemical technology is inadequately provided for, and about Rs. four lakhs could usefully be spent on developments for this purpose. A technical institute might be required at Dacca on a similar scale to those we have proposed for Bankipore and Cawnpore. This would make the total expenditure on capital account in Bengal Rs. ten lakhs.

The College of Engineering, Madras, at a cost of Rs. five lakhs, can be expanded into a technological institute to which the Leather Trade School should be attached.

In the Bombay Presidency there is already the Victoria Jubilee Technical Institute and the Poona College of Engineering; these can be usefully developed, the former with special reference to chemical, and the latter to electrical, technology, at an estimated cost of Rs. 2½ lakhs each.

Total for India	Rs. 47,00,000

Training of mechanical engineers, Rs. 40,00,000.

372. In connection with railway workshops or large engineering establishments, we propose the establishment of ten schools, each capable of dealing with about 200 apprentices. These schools would be located alongside suitable existing workshops, which would result in the following distribution :—one each in Madras, United Provinces, Punjab, Bihar and Orissa, Burma, and Assam, and two each in Bengal and Bombay. We estimate that each school will cost about Rs. four lakhs, made up as follows:—

	Rs.
Hostels for 200 apprentices	2,00,000
School buildings	75,000
Models, furniture, and equipment	25,000
Houses for staff	1,00,000
	4,00,000

No provision has been made for the cost of the site, as land can usually be provided free of cost.

For ten schools the capital charge will be Rs. 40 lakhs.

Workshops and laboratories attached to Directors' Offices, Rs. 8,00,000.

373. We gathered from the experience acquired in Madras that a technically qualified Director of Industries would find it extremely convenient, for the purposes of test and experiment, and for the expeditious transaction of current work, to have a small mechanical workshop and laboratory for both chemical and physical tests. Provision for the upkeep of this has been made under the heading of establishment, and the cost of materials and experiments would be met from the provision for experiments and demonstrations. These workshops and laboratories may be estimated to cost eventually from Rs. 50,000 to Rs. 1,00,000, but would only gradually be built up as work developes and

industrial progress is made. A total provision of Rs. eight lakhs, which would be spread over about five years, is deemed sufficient for this item.

Capital Expenditure—(b) Possible Schemes.

374. The remaining proposals involving capital expenditure are:— **Rs. 66,00,000.**

(1) The Metallurgical Research Institute at Sakchi.
(2) The Central Chemical Research Institute.
(3) The Imperial Engineering College.

In regard to the first two of these, however, we have only suggested their examination by expert committees; while we do not contemplate the early establishment of either the second or the third. It is, therefore, perhaps needless at this stage to do more than indicate roughly our own opinion of the scale on which we think they should be undertaken. In putting forward the figures given below we have carefully scrutinised the expenditure incurred in recent years on the highest-grade teaching and research institutes which have been started.

The Central Chemical Research Institute should be on a slightly larger scale than the Indian Institute of Science at Bangalore, and may, therefore, be estimated to cost Rs. 20 lakhs. The Imperial Engineering College should, we think, provide ultimately for about 500 students which, at the rate we have already given, *viz.*, Rs. 6,000 per head, would cost Rs. 30 lakhs. The Metallurgical Institute at Sakchi would probably provide a four years' course for 50 metallurgical students. Owing to the expensive character of the equipment required for metallurgical experiments, and the relatively small number of students to be provided for compared with the other technological institutes we have proposed, the capital cost may be taken at Rs. 8,000 per head, or Rs. 16 lakhs in all.

Summary of Estimates.

375. Statements II and III, appended to this Chapter, show in a tabular form the annual charges on account of the imperial and the provincial Departments of Industries, which amount to Rs. 24,63,900 and Rs. 98,98,500, respectively, or Rs. 1,23,62,400 in all. Only new expenditure has been included in the figures for the imperial department; but, in the case of the provincial estimates, it is necessary to set off against the proposed expenditure the existing charges, which cannot be exactly determined, but are approximately Rs. 38,00,000, including Rs. 27,00,000, shown in Table B as the existing cost of industrial and technical education, Rs. four lakhs for Factories and Boiler Inspection (para. 367), and Rs. seven lakhs on Industrial Departments. A further deduction should be made on account of local contributions, to which reference is made in para. 362, but it is impossible to estimate the precise share which local bodies may be willing to take in the provision of industrial education. Omitting this latter, the total additional recurring charges, therefore, would be in the neighbourhood of Rs. 86 lakhs.

In Statement IV the estimated capital expenditure under various heads is shown. It amounts to Rs. 150 lakhs, with a further possible expenditure of Rs. 66 lakhs. We consider that an annual grant of Rs. 30 lakhs for about seven years will meet the demands which are likely to be made if the schemes which we have recommended are carried out.

STATEMENT I.

Average salaries of administrative and controlling staff of provincial Departments of Industries.

—	Director.	Deputy Director.	Industrial Engineer I.	Industrial Engineer II.	Electric Inspector.	Commercial Intelligence Officer.	Total.	Establishment.	Total monthly charges.	Annual expenditure.	Travelling allowance.	Total.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Bengal . . .	3,000	1,500	1,250	1,000 1,000	1,500	1,500	10,750	7,500	18,250	2,19,000	15,000	2,34,000
Bombay . . .	3,000	1,500	1,250	1,000	2,000	1,500	10,250	7,000	17,250	2,07,000	15,000	2,22,000
Madras . . .	3,000	1,500	1,250	1,000	1,200	...	7,950	5,300	13,250	1,59,000	12,000	1,71,000
United Provinces .	2,500	1,500	1,250	1,000	1,200	...	7,450	5,000	12,450	1,49,400	12,000	1,61,400
Bihar and Orissa .	2,500	...	1,000	750	1,500	...	5,750	3,750	9,500	1,14,000	10,000	1,24,000
Burma . . .	2,500	...	1,000	750	1,200	...	5,450	3,650	9,100	1,09,200	12,000	1,21,200
Punjab . . .	2,500	...	1,000	750	1,200	...	5,450	3,600	9,050	1,08,600	10,000	1,18,600
Central Provinces .	2,500	...	1,000	750	1,000	...	5,250	3,500	8,750	1,05,000	10,000	1,15,000
Assam . . .	2,000	...	1,000	...	...	...	3,000	2,000	5,000	60,000	6,000	66,000
North-West Frontier Province.	1,500	...	...	...	...	...	1,500	1,000	2,500	30,000	3,000	33,000
												13,66,200

STATEMENT II.

Detailed statement of provincial recurring expenditure.

—	Bombay.	Bengal.	United Provinces.	Madras.	Bihar and Orissa.	Burma.	Punjab.	Central Provinces.	Assam.	North-West Frontier Province.	TOTAL.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Industrial Education	4,00,000	4,00,000	5,00,000	5,00,000	3,00,000	2,00,000	3,00,000	3,00,000	60,000	40,000	30,00,000
Technological Education	4,00,000	4,00,000	5,00,000	2,50,000	3,19,000	2,00,000	...	...	...	...	20,69,000
Training Mechanical Engineers	2,28,000	2,28,000	1,14,000	1,14,000	1,14,000	1,14,000	1,14,000	...	1,14,000	...	11,40,000
Experiments and Demonstrations	1,00,000	1,00,000	1,00,000	1,00,000	50,000	50,000	50,000	50,000	25,000	25,000	6,50,000
Circle Officers and Establishment	1,80,000	1,80,000	1,80,000	1,80,000	1,20,000	1,20,000	1,20,000	96,000	72,000	24,000	12,72,000
Factories and Boilers	1,61,000	62,000	41,900	64,300	700	17,300	28,500	25,600	...	...	4,01,300
Administration	2,22,000	2,34,000	1,61,400	1,71,000	1,24,000	1,21,200	1,18,600	1,15,000	66,000	33,000	13,66,200
TOTAL	16,91,000	16,04,000	15,97,300	13,79,300	10,27,700	8,22,500	7,31,100	5,86,600	3,37,000	1,22,000	98,98,500

STATEMENT III.

SUMMARY OF IMPERIAL AND PROVINCIAL RECURRING EXPENDITURE.

Imperial Expenditure.

	Rs.	Rs.
Department of Industries	5,47,400	
Commercial Intelligence	36,000	
Indian Trade Commissioner	25,500	
Stores	8,56,000	
Visiting Experts for Industrial Education	99,200	
Hydrographic Survey	3,00,000	
Central Chemical Laboratory	5,00,000	
Research and Demonstration Factories	1,00,000	
	24,64,100	
Less savings on Salt	200	
Total	24,63,900	24,63,900

Provincial Expenditure.

	Rs.	Rs.
Bombay	16,91,000	
Bengal	16,04,000	
United Provinces	15,97,300	
Madras	13,79,300	
Bihar and Orissa	10,27,700	
Burma	8,22,500	
Punjab	7,31,100	
Central Provinces	5,86,600	
Assam	3,37,000	
North-West Frontier Province	1,22,000	
Total	98,98,500	98,98,500
Grand Total		1,23,62,400

STATEMENT IV.

ESTIMATE OF CAPITAL EXPENDITURE.

(a) Recommended Schemes.

	Rs.
Industrial Schools	55,00,000
Technological Institutes	47,00,000
Mechanical Engineering Schools	40,00,000
Workshops and Laboratories attached to Director's Offices	8,00,000
	1,50,00,000

(b) Possible Schemes.

Metallurgical Institute	16,00,000
Imperial Engineering College	30,00,000
Central Chemical Institute	20,00,000
	66,00,000

CHAPTER XXIV.

SUMMARY OF RECOMMENDATIONS.

Chapter I. Rural India, past and present. Chapter II. Some Industrial Centres and Districts.

(1) The first two chapters are introductory and descriptive, the case of Burma being specially dealt with.

Chapter III. Raw Materials for Industries.

(2) Indian industries must be largely based on agricultural products, and the Agricultural Services require strengthening to undertake the necessary research work. Attention is specially directed to the problems presented by cotton cultivation, by sugar cultivation and manufacture, and the necessity for scientific work on oil seeds is brought to notice.

Vide Appendices B and C.

(3) The trade in hides and skins and the tanning industry are of great importance. The solution of the existing problems lies in stimulating the production of leather and of lightly-tanned hides and skins. The possession of an abundance and great variety of natural tan-stuffs lends special importance to this industry in India.

Vide Appendix D.

(4) The mineral resources of India offer opportunities for important developments.

Vide Chapters IV, XXII. Appendices F, F.

(5) The forest estates of Government yield inadequate returns, and an expert service of forest engineers is required to facilitate extraction. Provision for the training of forest engineers should be made in India.

(6) Special measures are required to bring timbers of the less-known species to the notice of consumers. Government depôts under the charge of officers selected for their commercial aptitude should be established for this purpose.

(7) The staff and equipment of the Forest Research Institute at Dehra Dun are insufficient and additions to the staff are necessary.

(8) The Departments of Industries should co-operate with the Forest Department to create the necessary link between the research officers and possible consumers of special timbers.

(9) Plantations should be established to secure a concentrated and, therefore, cheap supply of suitable wood for special industries and for fuel.

(10) Indian fisheries (especially deep-sea fisheries) have been neglected, except in the case of Madras, and their possibilities should be developed by properly equipped Fisheries Departments. Scientific ichthyologists should be added to the Zoological Survey. The creation of Fisheries Departments in Burma and Bombay, and a substantial addition to the staff of the Bengal Fisheries Department, are suggested.

Chapter IV. Industrial Deficiencies of India.

(11) The industrial deficiencies described show the national necessity of

establishing certain "key" industries. Where secret or very highly specialised processes of manufacture are involved, Government should take steps to facilitate their introduction.

Chapter V. Industries and Agriculture.

(12) There are many ways in which the employment of power or hand-driven machinery can assist the agriculturist, particularly in respect of irrigation, sugar production and oil milling.

(13) The demand for machinery for these processes would lead to the establishment of agricultural engineering works.

Vide Recommendation (132).

(14) Close co-operation between the Departments of Industries and Agriculture is needed.

(15) The Director of Industries in each province should have a workshop and laboratory equipped for the mechanical testing of small prime-movers and of the machinery that they are intended to drive.

(16) The possibility of irrigation in Sind by means of pumps should be considered in connection with the Indus barrage scheme, in order to estimate the commercial practicability of growing Egyptian cotton on a large scale.

Chapter VI. Power.

Vide also paragraph 26.

(17) A special survey of the coal situation in India should be undertaken at an early date, with a view to introducing economies in the methods of mining and consumption. Such a review of the fuel situation in eastern India should include an examination of the measures in progress for rendering more accessible the undeveloped fields of Assam.

(18) There are great advantages in using wood fuel after conversion into gas rather than directly, and, in particular, in employing charcoal for the production of gas after the removal of the by-products which are of value for industrial purposes. Any methods which are likely to cheapen the cost of fuel for gas plants should be the subject of detailed investigation and trial.

(19) Possible sources of industrial alcohol should be investigated. A liberal policy should be followed by the excise authorities when commercial requirements conflict with excise regulations.

(20) The utilisation of water power is of the highest importance in view of the necessity of creating electro-chemical and thermo-electric industries and of economising the use of coal. An organisation should at once be created by Government to carry out a systematic survey of the hydro-electric possibilities. Standard conditions for hydro-electric licenses should be prescribed.

(21) Leases of water power to private persons should provide for the resumption or transfer of rights and for the acquisition of the hydro-electric plant on an equitable basis, should it become necessary in the public interest, or should the initial industrial undertaking be compelled at any time to cease working.

(22) Proposals for generating water power from canal falls and other irrigation works should be considered by a joint committee composed of officers of the Public Works and Irrigation Departments.

Chapter VII. The Indian in Industries. Chapter VIII. Government Industrial Policy in recent years.

(23) These chapters are wholly descriptive.

Chapter IX. The Organisation of Scientific and Technical Services, and the Provision for Research Work in India and Abroad.

(24) In future all scientific officers should be recruited into imperial services, but placed under Local Governments or departments of the Government of India for administrative control. Their purely scientific work should be subject to the criticism and advice of the head of their service, transmitted through their administrative superiors. An imperial Indian Chemical Service is most urgently required.

(25) A special committee should be appointed, including a distinguished chemist from abroad, to formulate proposals for the permanent organisation and terms of service of the staff, and for the location and equipment of research laboratories.

(26) In the case of other scientific subjects, such as botany, bacteriology, zoology and entomology (which last should be recognised as a distinct administrative unit), imperial services should similarly be organised; and suitable committees might be appointed to work out details.

(27) Conditions are suggested to govern the relations between Government research officers and private industrialists who may desire to employ them on specific problems.

(28) Recruits for the scientific services should be drawn as far as possible from the Indian Universities and institutes. At first it will be necessary to import a number of specialists from England, but the ultimate object should be to man the services with officers trained in this country.

(29) The most promising bases for the establishment of specialised institutes of research will be at the chief centres of industries; but expert opinion is necessary to fix the location of these institutes. This subject should be included in the scope of enquiry of the committees recommended to work out the organisation of the scientific services.

(30) There are serious drawbacks to research work connected with Indian problems being undertaken abroad, and there is no longer any justification for the expenditure of Indian revenues on the maintenance of the Scientific and Technical Department of the Imperial Institute. In the rare cases which necessitate reference to British or foreign specialists, scientific officers in the Indian services should be empowered to communicate, through a recognised channel, with the Scientific and Technical Research Department recently established in England.

Chapter X. Industrial and Technical Education.

(31) The existing system of State technical scholarships for study abroad, though greatly improved by the revised Government rules recently issued, should not be utilised to enable students to acquire training in industries new to India. These scholarships should be granted only to men with some experience in existing industries, to enable them to acquire further specialised knowledge, and should not be awarded in respect of subjects for which adequate educational facilities are available in the country.

(32) Suitable primary education for the artisan and labouring population is urgently necessary. When private employers undertake the task of providing it, they should be assisted by Local Governments.

***Vide* also Recommendation (47).**

(33) Industrial schools should be controlled by the Departments of Industries. Their head masters must possess practical skill in the industries taught and knowledge of their economic conditions. These schools are a means of suitable training for cottage, but not for organised, industries.

(34) Organised industries may be divided into two classes, manipulative, such as mechanical engineering, and non-manipulative or operative, such as the manufacture of chemicals. Training for manipulative industries should be given in the works themselves, to which theoretical classes should be attached. There are certain cases where the individual concerns are not large enough for this; these can sometimes be conveniently dealt with by central teaching institutions serving a group of works; but where such an arrangement is impossible, and in the case of the textile trade where the preliminary training can best be given in a school, instruction may be more conveniently provided in technical schools with workshops or instructional factories attached.

(35) In the case of non-manipulative industries the necessary training can usually be given in a teaching institution; but practical experience is needed if the student is to rise in his profession. In these industries, the instruction should be mainly technological, *e.g.*, in a branch of applied chemistry, with some training in engineering, and can be given in a teaching institution. The necessary practical experience must be gained in the factory, in which the student's technological training will qualify him at once for employment.

(36) The training required for mechanical engineering, as an example of a manipulative industry, is discussed in detail.

(37) At the large engineering shops practical training should be given to artisan apprentices on an organised system, with teaching in shop hours; and the apprentices should be paid wages, a part of which they might receive in the form of deferred pay on leaving.

(38) In the case of foremen a system of apprenticeship on conditions that should attract middle-class Indian youths is suggested, with teaching in shop hours of a more advanced type than in the case of artisan apprentices, and providing for boys who would start at a somewhat higher age.

(39) In the case of mechanical engineers also, the large engineering shops should be used as the practical training ground; but a greater proportion of the time should be devoted to theoretical teaching of a higher kind than is necessary for foremen. Those students who desire it may, after completing their shop training, take courses in special subjects at an engineering college.

(40) The engineering colleges should, as soon as is practicable, make over the training of subordinates to lower-grade institutions, and should add departments for technological training. These colleges should be administered by Councils, on which the University, the Departments of Industries, and employers should be represented, while the Council should have the privilege of electing a certain number of its members to represent it on the University Senate. The Universities would decide which of the college courses should qualify students to sit for a degree.

(41) In addition to the existing provincial institutions, two imperial colleges seem likely to be needed ultimately, one for the highest-grade teaching of engineering and the other for metallurgy and mineral technology.

(42) Government should encourage the foundation in India of scientific and technical societies on the lines of the London institutions.

(43) It is recommended that the engineering classes in the Victoria Jubilee Technical Institute, Bombay, should be adapted to meet the requirements of the apprentices in the railway and other workshops in Bombay, and that the courses in technology should be supplemented by two years' practical work before the full diploma can be gained.

(44) As regards mining, the evening classes on the coal fields should be retained and improved ; and the scheme put forward for a school of mines at Dhanbaid is preferable to the present arrangements at Sibpur and should be adopted. Meanwhile, the existing course at Sibpur should be improved.

(45) The technical school at Sakchi for metallurgical training proposed by the Bihar and Orissa Government is approved, but without prejudice to the possibility of a higher-grade institution.

(46) In respect of commercial education it is of the utmost importance to secure the co-operation of commercial men. Commercial colleges should be administered by Councils consisting largely of business men with representatives of the Universities ; these Councils should also elect from among their members delegates to the University Senates. The Universities should retain the right to prescribe which courses of the colleges shall qualify a student to sit for a University degree.

(47) All industrial and technical institutions of less than collegiate rank should be controlled by the Department of Industries, though the advice and co-operation of the Department of Education is desirable.

***Vide* also Recommendation (33)**

(48) To prevent inefficient or misdirected teaching, inspection and advice by officers of the imperial Department of Industries would for some time be of great assistance to provincial departments.

Chapter XI. Commercial and Industrial Intelligence.

(49) Commercial and industrial statistics should not be commented on except by an agency which has expert knowledge of their significance. The Director of Statistics should be a compiling officer only.

(50) The Director of Commercial and Industrial Intelligence, whose headquarters should be in Calcutta, should be supplied with information by provincial Directors and by the special provincial intelligence officers proposed for Calcutta and Bombay. The help of commercial associations should be utilised so far as possible.

(51) He should advise the Government of India regarding commercial questions, especially those relating to overseas trade. He should also answer enquiries from the public, but should refer those relating to technical matters to the appropriate expert department.

(52) Crop forecasts should be prepared by the Agricultural Department, as soon as its staff is sufficiently strong to undertake the task.

(53) More complete information regarding industrial employment and production is required.

(54) The Indian Trade Commissioner in London should be assisted by temporarily seconded members of the Agricultural, Forest and Geological Survey Departments.

(55) Government should consider the desirability of establishing Indian trade agencies after the war in other countries, such as East Africa and Mesopotamia.

(56) The Indian Trade Journal should be replaced by periodical bulletins. More use should be made of the press for disseminating current industrial and commercial information.

Chapter XII. Government Purchase of Stores.

(57) The creation of an organisation for the purchase and inspection of stores in India is recommended working under the Imperial Department of Industries and the local Departments of Industries in each province.

(58) The appointment of a small expert committee is proposed to consider the precise allocation of spheres of action between the imperial and provincial agencies.

(59) All indents for Government and railway stores should be met, as far as is practicable, in India. Indents from provincial officers should be dealt with first by the provincial Directors, who should fill them to the utmost possible extent from local manufactures.

(60) The remaining items should be forwarded to the Controller-General of Stores with the Government of India, who would issue orders for those items which could be advantageously obtained in India and would purchase the residue through the Stores Department of the India Office. Indents from Government railways and from such other railways as desire to participate in the scheme should be dealt with by the Controller-General of Stores, in the same way. The stocks would not be held by the Stores Department.

(61) Provincial Departments of Industries should, so far as their equipment permits, inspect the goods supplied through them. They should include, in the larger provinces, an experienced officer who would be responsible for local purchases. Interchange of information with one another and with the Controller-General of Industries would make it possible for provincial Directors to purchase stores from other provinces direct.

(62) For some time to come inspection work should be performed mainly by an imperial inspecting staff, which would also collect information regarding the manufacturing possibilities of the country.

(63) The purchase of stores in India would be facilitated by the existence of an agency in India for preparing specifications in certain cases.

(64) The Controller-General of Stores should have his headquarters at Calcutta and should work in close contact with the Director of Commercial and Industrial Intelligence. His annual report should include, for the information of manufacturers in India, a classified statement of the articles obtained by him here and from abroad.

Chapter XIII. Land Acquisition in relation to Industries.

(65) Provision should be made, where necessary, in local laws to enable persons, who are prevented by legal restrictions from transferring their lands or from conferring an absolute title therein, to do so with the sanction of some proper authority, when the land is required for an industrial enterprise, more particularly for the housing of industrial labour.

(66) Government seems to have been uncertain in the past as to the applicability of the Act to land required by industrial concerns ; and a criterion is proposed by which the Local Government may determine the cases in which compulsory acquisition under section 40 (i) (*b*) of the Land Acquisition Act may be effected on behalf of an industrial concern. These suggestions apparently do not involve any amendment of the Act, though, if they do, this should be undertaken.

(67) In certain cases, on the recommendation of local bodies, Government should compulsorily acquire land to provide fresh sites for industries, which it is necessary to remove on grounds of public health, and for industrial dwellings. ***Vide* also Chapter XVI.**

(68) In all cases where land is acquired compulsorily for industrial enterprises, cultivators or house owners so dispossessed should be offered suitable land in exchange or part exchange.

Chapter XIV. Technical Assistance to Industries by Government.

(69) Direct technical assistance by Government is necessary to encourage certain classes of industries.

(70) The functions and limitations of pioneering and demonstration factories are described.

(71) For cottage industries, peripatetic demonstrations of improved processes and machinery are most important, and the provision of new patterns and designs must be arranged for. The organisation of production by the establishment of small auxiliary factories and the employment of labour-saving devices are very desirable. ***Vide* also Chapter XVII. Chapter XVIII.**

(72) For organised industries, in addition to assistance in starting new industrial undertakings, useful work can be done by Government in helping the owners and managers of small power plants to maintain them in good working condition.

(73) While ordinarily Government should itself carry on industrial operations only for the manufacture of lethal munitions, it will be necessary in some cases to control and assist private factories capable of producing military necessities. Assistance will also be required for industries of national economic importance.

(74) The above duties cannot be performed without properly equipped Departments of Industries, both imperial and provincial. While the utmost possible decentralisation is desirable, there are certain functions for which the Imperial Government must be responsible.

Chapter XV. Miscellaneous Points of Government Law and Practice affecting Industries.

The Employment of Jail Labour.

(75) Power-driven machinery should not be allowed in jails. Provincial Directors of Industries and their Boards should be authorised to make recommendations to the Local Government on the employment of jail labour.

The Prevention of Adulteration.

(76) The legislation now being undertaken by provincial Governments for the prevention of the adulteration of foodstuffs and drugs is approved. The agency for enforcing the existing Acts should be considerably strengthened.

(77) Regarding the adulteration of raw produce for export or local manufacture, action should be left to the trade itself. Government should do what it

can to strengthen the hands of local mercantile bodies who are interested in such matters.

(78) A system of Government certificates of quality is impracticable and unnecessary, except in the case of fertilisers, for which an Act similar to the Fertilisers and Feeding Stuffs Act of 1906 (Great Britain) should be introduced.

The Administration of the Boiler and Prime-Mover Acts.

(79) The principles laid down by the Public Services Commission in dealing with the Boiler Inspection Department are endorsed. The following recommendations are added:—

(*a*) Boiler inspection should be a duty of the provincial Departments of Industries.

(*b*) The rules for determining permissible pressures for boilers should apply to the whole of India.

(*c*) The laws compelling persons in charge of boilers to possess certificates should be abolished.

The Mining Rules.

(80) The favourable consideration of Government is asked for the proposed strengthening of the Geological Survey, which should include a suitable staff to inspect Government concessions and to advise small mine owners.

(81) Such inspection would insure the due fulfilment of the conditions of prospecting licenses and permit of their being framed on more elastic lines. Local Governments should have power to extend their duration up to 5 years in cases where the work of proving the existence of minerals necessitates operations on a very extensive scale.

(82) The present mining lease form might be considerably shortened and simplified by including some of its provisions in local rules.

(83) Certain provinces should prepare Mining Manuals similar to those published in the Central Provinces and Burma.

The Administration of the Electricity Act.

(84) The status of Electric Inspectors should be improved in order to secure more highly qualified men.

(85) To ensure intelligent liberality in the interpretation of the rules, the appointment of provincial Advisory Boards, as contemplated in section 35 of the Act, is proposed. These Boards should be permitted, when necessary, to consult experts such as the Electrical Adviser to the Government of India.

(86) Government should encourage the industrial use of electricity supplied from central generating stations. The law should, if necessary, be amended, so as to permit of the load factor being taken into account in fixing the charges.

(87) The Electric Inspectors should be transferred from the control of the Public Works Department to that of the Department of Industries.

Patents, Trade Marks, and Business Names.

(88) No change is needed in the existing patent law, which seems well suited to Indian conditions, nor is it desirable at present for India to join the International Convention, but the position may have to be reconsidered if patent law is consolidated throughout the Empire.

(89) The registration of trade marks or business names is not recommended.

Registration of Partnerships.

(90) With a view to legislation to secure the compulsory registration of partnerships, Government should consider a suggestion that members of a joint Hindu family should be regarded as a single unit for the purposes of registration.

Chapter XVI. The Welfare of Factory Labour.

(91) The inefficiency of Indian labour can be remedied by the provision of education, the amelioration of housing conditions, the improvement of public health, and a general policy of betterment.

Vide **Recommendation (32).**

(92) Compulsory education should be introduced for all classes of children in areas where this is feasible; the question of amending the Factories Act may then be considered, if necessary.

Vide **Recommendation (67).**

(93) As regards housing it has already been recommended that Government should use its power to acquire land on behalf of employers for the housing of labour, subject to certain safeguards.

(94) Land might also be acquired at the cost of Government or of the local authorities concerned, which they might lease at easy rates to employers for erecting industrial dwellings.

(95) Local authorities should be responsible for the development and lay-out of industrial areas on suitable lines, and for securing the maintenance of proper sanitary conditions in such areas.

(96) It would be undesirable and unjust to compel individual employers to house their own labour.

Special proposals for Bombay.

(97) The question of congestion in Bombay must however be taken up at once. The scheme for industrial housing prepared by the Improvement Trust might be continued along with the measures which are proposed below to meet the special difficulties existing in Bombay.

(98) To avoid congestion in future no industrial concerns should be started, except in the north-east of the island of Bombay or in south-east of Salsette, without the consent of the Municipality. In the area set aside for industrial development, the requisite powers should be taken by the local authorities to determine whether certain classes of industries should be admitted to certain sites, and the necessary steps should be taken to ensure the development of the settlement on sanitary lines.

(99) To relieve existing congestion, the railways should be induced to locate their new workshops at a reasonable distance from the city and to furnish accommodation for their labour *in situ*. Government departments and public bodies should provide housing of a suitable type for their workmen, where possible in the northern industrial area.

(100) The establishment of improved means of communication, including the electrification of suburban railways, and the extension of the tramway system, with the object of creating an industrial suburb, is required.

(101) In the case of employés of industries located in the city, a definite standard of accommodation for industrial dwellings should be determined, and a programme of construction worked out and taken up at the expense of the local authorities who should then manage the buildings. If the existing resources of these bodies, together with such assistance as the Local Government may be able to spare, are not sufficient, further taxation should be imposed, mainly on employers.

Proposals of general application.

(102) The possibility of reducing the present maximum factory hours, whether by a shift system or otherwise, requires further examination, as the shortening of working hours may have an important influence in raising the standard of comfort, when the workers have learned to employ their leisure hours more profitably.

Vide **Appendix L.** (103) The policy proposed by the Sanitary Commissioner will improve the public health and the efficiency of labour.

(104) The responsibility for general welfare work among factory labourers must devolve mainly on private individuals and associations. Government and local bodies, as well as employers, should however assist them as far as possible.

Chapter XVII. Cottage Industries.

Vide **Appendix I.** (105) The ordinary census provides an unsatisfactory means for the collection of useful occupational statistics, and special enquiries or surveys are needed.

Vide **Appendix G.** (106) The establishment of central silk-reeling and twisting factories is desirable.

(107) The introduction of better tools and plant and of a more minute subdivision of processes should be encouraged by Departments of Industries.

(108) In the case of weaving, provision should be made in the weaving schools for the instruction of a small number of pupils of a higher class, with better educational attainments and prospects of being able to start for themselves in business. They should be given practice in the control of workmen, and should receive a training in the commercial as well as in the technical side of their profession, either in private undertakings run with Government assistance as demonstration factories, or in commercial sections attached to the industrial schools.

(109) Directors of Industries should be empowered to grant small loans to cottage workers and to supply tools and plant on the hire-purchase system.

(110) Provincial art officers should maintain a close connection with the craftsmen and supply them with new ideas and designs. Periodic exhibitions should be held, advertisements issued, and attempts made to introduce the art productions of the country to outside markets.

Vide **Recommendation (114.)** (111) Emphasis is laid upon the necessity for improving the methods of marketing the products of cottage industries. The Departments of Industries must create or stimulate the creation of sale agencies in India and, where possible, abroad.

Chapter XVIII. Co-operation for Small and Cottage Industries.

(112) The way to industrial co-operation must be paved by familiarising workers with the principles of co-operative credit.

(113) Certain co-operative functions, such as the joint use of machinery, can be better achieved by bodies created *ad hoc*, than by superimposing them as an additional object on existing primary societies.

(114) The difficulty of industrial co-operation lies largely in the absence of expert but disinterested non-official business helpers. This may be remedied, either (*a*) by the introduction of the small entrepreneur, which, however might not prove advantageous to the worker in the long run, or (*b*) by the establishment of sale organisations managed either by Government or by private persons. Government should be prepared to risk some loss on experiments in this direction.

(115) Direct assistance in the form of loans should be given by Government to agricultural or industrial societies for the purchase and employment for the common advantage of comparatively costly machinery and plant. The Director of Industries should initiate industrial societies and should give them advice in technical and commercial matters after they are started; but he should not interfere with the administration of the Act and rules. ***Vide* Recommendation (129).**

(116) The Departments of Industries, Agriculture and Co-operation must work closely together. ***Vide* Recommendation (132).**

Chapter XIX. Industries and Transport.

(117) Internal traffic, especially in the cases of raw materials conveyed to, or manufactured materials conveyed from, manufacturing centres should be rated as nearly as possible on an equality with traffic of the same class and over similar distances to and from the ports.

(118) Rates on traffic to ports should be fixed on the principle of what the export traffic can stand over its whole journey to the port of foreign destination.

(119) The same principle should apply to imports, but the lowest possible rates should be allowed for machinery and stores imported for industrial use in India.

(120) The whole distance travelled by a consignment, and not the distance travelled over individual lines, should be taken as the basis, when tapering rates apply. The way in which these rates, as well as 'block' rates and 'terminal charges', have been applied in the past, has tended to operate against Indian industries. The total freight charge for a consignment passing over several lines should be calculated as a single sum, which should be shared between the different railways, allowance being made, where necessary, for any extra cost incurred by a particular line.

(121) The addition of a commercial member to the Railway Board is suggested.

(122) Indian industries and commerce should be represented by officers of the Department of Industries and also by members of recognised commercial bodies at the Railway Conference and at the meetings of the Goods Classification Committee.

(123) Special rate concessions for a term of years might be given to new industries, when investigation by the Department of Industries shows this to be necessary.

(124) Government should take up the question of improving the existing waterways and should give early consideration to the prospective advantages of a Waterways Trust in Calcutta.

(125) The Department of Commerce should take steps to secure harmonious working between railway and waterway administrations (including coastwise traffic) for the development of those parts of the country which are served by both.

Chapter XX. Industrial Finance.

(126) In order to meet the difficulties experienced by small and middle-class industrialists in obtaining financial facilities and generally to provide a more elastic system of industrial finance, industrial banks are needed. An

expert committee should be appointed to consider what additional banking facilities are necessary, whether for the initial or for the current finance of industries; what form of Government assistance or control will be required to ensure their extension on sound lines as widely as possible throughout the country; and whether they should be of provincial or of imperial scope, or whether both these forms might not be combined in a group of institutions working together.

(127) A scheme is explained for the provision of current finance for middle-class industrialists, by which the banks would lend money, subject to a guarantee by Government after an examination by the Director of Industries and his expert staff of the financial standing of the applicant and the prospects of his business. This scheme deserves attention, at any rate as an interim measure until industrial banking facilities are more general.

(128) In a few cases Government should provide direct financial aid. Such assistance might take the form of guarantees of dividends, loans of money, undertakings to purchase output, or contributions to share capital. All these forms of aid should be subject to suitable precautions. Government directors, when appointed, should not act so as to delay decisions. Where industrial undertakings receive Government aid, their capital should be raised in India, under conditions which will give opportunities to small investors and encourage Indians to participate in industrial ventures. Assistance of this kind to 'national safety' undertakings should be a matter for the Imperial Government; in other cases, it may be given by Local Governments, if they possess the necessary expert staff to estimate the prospects of the proposed undertaking.

(129) Assistance should also be given to small and cottage industries by the local Departments of Industries in the shape of small Government loans or by financing the purchase of plant on the hire-purchase system. Fresh legislation would be required to ensure a ready means of recovery of the money so advanced.

Chapter XXI. Provincial Departments of Industries.

(130) The creation of specialised Departments of Industries is necessary to co-ordinate the various forms of provincial activity which have been suggested, and to perform certain functions at present entrusted to other non-specialised agencies.

(131) The establishment is required in each province of a Department of Industries under a Director, who should act as Secretary to Government for commercial and industrial subjects.

(132) To ensure that the Departments of Industries, Agriculture and Co-operative Credit work in close harmony, they should be under the control of the same Member of the provincial Executive Council.

(133) The Director of Industries should be assisted by a Board whose members should be appointed by Government, in some cases on its own selection, in others on nomination by suitable public bodies. Where the Board and the Director disagree, the matter should be referred to superior authority. The Board should consist of not less than 6 or more than 12 persons, who should be mainly non-official. The members of the Board and of sub-committees formed for special purposes might be offered fees and travelling allowances.

(134) The Board should have power to co-opt members for temporary or special purposes and to appoint standing or temporary sub-committees.

(135) The Department of Industries should consist, in addition to the Director, of a Deputy Director (in the larger provinces), industrial engineers, chemists, industrial specialists and teachers, and certain other officers. Initially, these officers may be recruited as circumstances best allow; but as the Imperial Industrial and Scientific Services are established, the provincial department should obtain its superior officers from these services. They should be entirely under the orders of the Local Government. Specialists in various lines of applied technology who are engaged in teaching would also serve as advisers to Government and to private industrialists. Subordinate officers with a knowledge of mechanical engineering will be required in territorial charges to help small industries.

Chapter XXII. An Imperial Department of Industries.

(136) The direction and co-ordination of the general industrial policy of the country and the proper performance of certain functions of high national importance can only be effected through an Imperial Department of Industries, in charge of a Member of the Viceroy's Executive Council; and there is a sufficient number of closely correlated functions to justify the creation of a specialised imperial department for their performance.

(137) Special arrangements are, however, required to secure the prompt and efficient performance of the administrative and executive duties which will fall to the lot of the imperial department; and also to free the Member in charge from routine work, and to leave him leisure to deal with questions of policy. For this purpose we propose the creation of a Board to be called the Indian Industries Board, consisting of three members with separate charges. The Member in charge of the Department should be President of the Board without any special portfolio, but with full power to overrule his colleagues, who, however, should have the right to place on record their opinions. The Members of the Board should ordinarily hold office for five years only. There should also be a Secretary to the Board and the Department, as well as three Assistant Secretaries to the Board.

(138) The various subjects and departments which the Department of Industries would control, including those to be transferred to it from other existing departments of the Government of India, fall into the following natural groups.

Group I.—

Geology and Minerals.
Salt.
Explosives and Petroleum.
The Chemical Service and chemical research.
Government factories for research or demonstration.

Group II—.

Stationery and Printing.
Commercial and industrial intelligence.
Stores.
Factories Act.
The general encouragement of industries.
Technical and industrial education.

Group III.—

Inventions and Designs.
Steam boilers Acts.
Electricity.
Ordnance Factories.
Inspection of ordnance manufactures.

Each of these should be under a separate member of the Industries Board, who would control the departments subordinate to him.

(139) In order to secure unity of administration, the headquarters of the Board should be with the Government of India, though its members should tour frequently.

(140) The Board and the Department should be assisted by a part-time Financial Adviser, who should be given a seat on the Board.

(141) An examination of the functions and qualifications of the officers subordinate to the Board, of the members of the Board itself, and of the higher provincial officers, shows that all require technical, business and administrative experience for the proper performance of their duties.

(142) It therefore seems necessary to create an Imperial Industrial Service to meet the requirements of the industrial departments throughout the country. This will also afford a means of training qualified Indians to fill the higher appointments.

(143) The ordnance factories, if they are to be managed by a civil department, should have their own separate service, though they may exchange officers with the Imperial Industrial Service.

(144) Officers of the Imperial Industrial Service should be recruited as far as possible in India.

(145) Before a regular Industrial Service has been built up, appointments will have to be made from various sources, often on special terms.

CONCLUSION.

We have briefly sketched the lines of economic development along which India has moved since she first came into contact with western traders; and have described in somewhat more detail the commercial and industrial position to which these lines of development have led her. We have shown that this position has become in many ways disadvantageous to the interests of the country; and that India's industrial equipment is impaired by deficiencies which affect the interests of national safety. The industrial system is unevenly, and in most cases inadequately, developed; and the capitalists of the country, with a few notable exceptions, have till now left to other nations the work and the profit of manufacturing her valuable raw materials, or have allowed them to remain unutilised. A powerful and well-directed stimulus is needed to start the economic development of India along the path of progress. Such a stimulus can only be supplied by an organised system of technical, financial, and administrative assistance.

Our report in its finally approved form was in the hands of the printers before the appearance of the Chelmsford-Montagu report on Indian constitutional reforms. We were unable, therefore, to re-examine in detail our conclusions and recommendations in the light of the reform proposals without incurring a delay which would have been undesirable. It is evident, however, that our scheme is in general accord with the administrative changes proposed by His Excellency the Viceroy and the Secretary of State.

We are deeply conscious of the difficulties of the question with which we have been asked to deal, and of its vital importance to the future of the country. We have had to discuss a vast range of subjects requiring expert knowledge, which was not always adequately available in the country under present conditions. The circumstances of India have made it necessary for us to devise proposals which will bring the State into far more intimate relations with industrial enterprise than the policy of Government or public opinion has hitherto permitted. But as regards our main proposals—technical education in practical relation to industrial requirements, the supply of advice and assistance through organised scientific and technical services, the provision of more liberal finance for industries, so far as possible through private agency—we feel confident that these are solutions clearly indicated by the very difficulties which they are designed to surmount, as well as by the small degree of Indian experience available, and substantially supported by the best-qualified opinion of the country. Finally, we have been strongly impressed by the earnest demand throughout India for economic progress and by the growing realisation of the dangers to which industrial unpreparedness exposes a nation. We feel sure that the strongest support will be forthcoming from the public generally, and from Indian capitalists and industrialists in particular, to any well-considered scheme for industrial progress which Government may see fit to adopt, and we submit our report in the earnest hope that our recommendations will, with the approval of Government and the good-will of the Indian public, help in some measure towards the ideal of an India, strong in her own strength, and a worthy partner in Empire.

(Signed) T. H. HOLLAND,
President.

„ ALFRED CHATTERTON.

„ FAZULBHOY CURRIMBHOY.

„ C. E. LOW.

„ M. M. MALAVIYA.*

„ R. N. MOOKERJEE.

„ F. H. STEWART.

„ D. J. TATA.

R. D. BELL
G. H. W. DAVIES } *Secretaries.*

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* Subject to a separate note.

NOTE

BY

THE HON'BLE PANDIT MADAN MOHAN MALAVIYA.

Introductory.

On the 21st March 1916, the Hon'ble Sir Ibrahim Rahimtoola moved a Resolution in the Imperial Legislative Council urging the appointment of a Committee to consider and report what measures should be adopted for the growth and development of industries in India. Among the matters which he suggested might suitably be referred for the consideration of the Committee, he put in the forefront the question—

> "Whether representation should be made to the authorities through the Secretary of State for India for securing to the Government of India full fiscal autonomy, specially in reference to import, export and excise duties."

In the course of his speech in supporting the Resolution, the Hon'ble Member laid great stress on this point. He said:—

> "I readily recognise that efforts are being made by the Government in many directions to meet the needs of the situation. It appears to me, however, that, unless the hands of the Imperial Government are free in fiscal matters, the results will not be adequate. If the Government of India were free to adopt measures solely in the interests of the people of this country, without any restrictions or limitations in fiscal matters, our industrial development would be in a fair way of successful accomplishment. India wants fiscal autonomy as the first step towards her industrial regeneration, and if Indian public opinion is to have any weight in the determination of this question, we ought to get it at once."

The Hon'ble Sir William Clark, the then Member for Commerce and Industry, accepted the Resolution on behalf of the Government. He announced that the Government had anticipated the recommendation of the Resolution, and had already taken steps to constitute not a committee, but a more important body, a Commission, whose duty it will be to consider and report upon the possibility of further industrial development in this country. He said at the same time that, for reasons which he put before the Council, the scope of the enquiries entrusted to the Commission would not include a consideration of the question of fiscal policy of the Government. Sir William Clark noted that in the opinion of the mover of the Resolution "a Government of India, uncontrolled by the Secretary of State, untrammelled by the conceptions of fiscal policy which may be held by the British Government of the day, would be a far more potent instrument for the development of industries in India than the administration of this country under its present constitution." He also recognised that there was "a weighty body of opinion tending in that direction." But he said that "His Majesty's Government feel that the fiscal relationships of all parts of the Empire as between one another and the rest of the world, must be reconsidered after the war, and they wish to avoid the raising of all such questions until that fortunate time shall have arrived." It was therefore stated in the Resolution appointing this Commission that "any consideration of the present fiscal policy of the Government has been excluded from its enquiries," and that "the same considerations apply with even greater force to any proposals involving the imposition of duties for the specific purpose of protecting the Indian industries, a policy which would very directly affect the fiscal relations of India with the outside world." This will explain why, as Sir Frederick Nicholson put it in his statement submitted to us, 'the part of Hamlet must be totally omitted.'

The Commission has been instructed to examine and report upon the possibilities of further industrial development in India and to submit its recommendations with special reference to the following questions :—

> " (*a*) whether new openings for the profitable employment of Indian capital in commerce and industry can be indicated;
>
> " (*b*) whether and, if so, in what manner, Government can usefully give direct encouragement to industrial development—
>
> " (*i*) by rendering technical advice more freely available;
>
> " (*ii*) by the demonstration of the practical possibility on a commercial scale of particular industries;
>
> " (*iii*) by affording, directly or indirectly, financial assistance to industrial enterprises; or
>
> " (*iv*) by any other means which are not incompatible with the existing fiscal policy of the Government of India."

In the course of the speech to which reference has been made, Sir William Clark made it clear that "the building up of industries where the capital, control and management should be in the hands of Indians" was "the special object which we all have in view." He emphasised that it was of immense importance alike to India herself and to the empire as a whole, that Indians should take a larger share in the industrial development of their country. He deprecated the taking of any steps, if it might "merely mean that the manufacturer who now competes with you from a distance would transfer his activities to India and compete with you within your boundaries." It was the same object of finding out how to help *Indians* to develope industrial and commercial enterprise, that led the Government of India to depute Professor C. J. Hamilton, the Minto Professor of Economics in Calcutta, to visit Japan "to obtain more detailed particulars for the use of the Industrial Commission," so that we may "know exactly what her Government has done to aid her people in the notable advance which they have made," having "developed a structure of modern industrial and commercial enterprise from a past which knew nothing of western economic conditions." We have to keep this object clearly before our mind in dealing with the questions which we have to examine and report upon.

India—Past and Present.

In the revised note which Professor Hamilton submitted to the Commission, after dwelling on the rapidity with which Japan has transformed herself from a country where "agriculture absorbed the energies of the bulk of the population" to one of the important manufacturing countries of modern times, he says :—

> "The second fact, even more arresting from an Indian point of view, is that this remarkable transformation has been achieved by an Asiatic community. The Asiatics have long been regarded as intensely conservative, unprogressive, needing the help and guidance of western nations for the maintenance of law and order, and, even with their assistance, being with difficulty persuaded to adopt the modern aims and methods associated with economic progress."

Mr. Hamilton does not stand alone in this view. In the course of my work connected with this Commission, I have repeatedly been reminded of the erroneous notion which many a European holds that India is, and must remain, a mainly agricultural country, that the people of India are by nature and tradition deficient in industrial capacity and commercial enterprise, and that these qualities are inherent in the nations of the West. It is necessary to combat this notion, for it vitiates judgment regarding the capacity of Indians. It is also necessary for a proper appreciation of the present industrial condition of India and of the possibilities of its future development, that the facts and circumstances of the past should be correctly known and appreciated.

I agree with my colleagues that " at a time when the west of Europe, the birthplace of the modern industrial system, was inhabited by uncivilised tribes, India was famous for the wealth of her rulers and for the high artistic skill of her craftsmen," and that " even at a much later period when traders from the West made their first appearance in India, the industrial development of this country was at any rate not inferior to that of the more advanced European nations." But I do not agree with them as to the causes which they assign for the subsequent growth of industries in England, and, by implication, for the want of the growth of such industries in India. They say :—

> " But the widely different social and political conditions of the West had helped the middle class to establish itself on a foundation of commercial prosperity, and the struggles for political freedom and religious liberty in which it had taken its share had endowed it with a spirit of enquiry and enterprise that was gradually and increasingly directed to the attainment of industrial efficiency," and that " it was to this middle class that the so-called 'industrial revolution' of the eighteenth century was mostly due."—(paragraph 1 of the Report.)

Similarly it is stated in paragraph 134 of the Report that :—

> " The history of the evolution in the West of new industrial methods which culminated in the rapid and striking changes of the latter half of the eighteenth century shows that a large part was played therein by the educated as well as by the capitalist classes. The encouragement of scientific research and its practical application by the Royal Society, and at a later stage by the Society of Arts, was closely paralleled by the fresh industrial ventures constantly being set on foot by merchants and other persons with capital at command. When the results began to reach India in the shape of machine-made imports, the movement had passed beyond the stage where the gradual evolution which in England had taken place could be readily imitated in India."

In my opinion this does not give a correct view of the matter, and is calculated to support erroneous ideas about the natural capacity of Indians and Europeans for industrial enterprise, and to stand in the way of right conclusions being reached as to the possibility of industrial development in India with the co-operation of the Government and the people. I must therefore refer a little more fully to the economic history of India and of the 'industrial revolution' of England which has greatly affected that history.

India—A Manufacturing as well as an Agricultural Country.

" The skill of the Indians," says Professor Weber, " in the production of delicate woven fabrics, in the mixing of colours, the working of metals and precious stones, the preparation of essences and in all manner of technical arts, has from early times enjoyed a world-wide celebrity." There is evidence that Babylon traded with India in 3000 B.C. Mummies in Egyptian tombs, dating from 2000 B.C., have been found wrapped in Indian muslin of the finest quality. " There was a very large consumption of Indian manufactures in Rome. This is confirmed by the elder Pliny, who complained that vast sums of money were annually absorbed by commerce with India." " The muslins of Dacca were known to the Greeks under the name of *Gangetika* . . . Thus it may be safely concluded that in India the arts of cotton spinning and cotton weaving were in a high state of proficiency two thousand years ago . . . Cotton weaving was only introduced into England in the seventeenth century."—(*Imperial Gazetteer of India*, Volume III, page 195.)

As regards iron manufactures, Professor Wilson says:—"Casting iron is an art that is practised in this manufacturing country (England) only within a few years. The Hindus have the art of smelting iron, of welding it, and of making steel, and have had these arts from time immemorial." Mr. Ranade wrote in 1892:—

> "The iron industry not only supplied all local wants, but it also enabled India to export its finished products to foreign countries. The quality of the material turned out had also a world-wide fame. The famous Iron Pillar near Delhi, which is at least fifteen hundred years old, indicates an amount of skill in the manufacture of wrought iron, which has been the marvel of all who have endeavoured to account for it. Mr. Ball (late of the Geological Survey of India) admits that it is not many years since the production of such a pillar would have been an impossibility in the largest factories in the world, and, even now, there are comparatively very few factories where such a mass of metal could be turned out. Cannons were manufactured in Assam of the largest calibre, Indian *wootz* or steel furnished the materials out of which Damascus blades with a world-wide reputation were made; and it paid Persian merchants in those old times to travel all the way to India to obtain these materials and export them to Asia. The Indian steel found once considerable demand for cutlery even in England. This manufacture of steel and wrought iron had reached a high perfection at least two thousand years ago."—(Ranade's *Essays on Indian Economics*, pages 159-160.)

There is abundant testimony to prove that at the date of the invasion of Alexander, as for centuries before it, the people of India enjoyed a high degree of prosperity, which continued to the breaking up of the Moghal Empire in the eighteenth century.

> "All the descriptions of the parts of India visited by the Greeks," Mr. Elphinstone tells us, "give the idea of a country teeming with population, and enjoying the highest degree of prosperity . . . The numerous commercial cities and ports for foreign trade, which are mentioned at a later period (in the 'Periplus'), attest the progress of the Indians in a department which more than any other shows the advanced state of a nation. (Page 263) . . . Arrian mentions with admiration that every Indian is free. . . . The army was in constant pay during war and peace. . . . The police is spoken of as excellent. Megasthenes relates that in the camp of Sandracottus, consisting of 400,000 men, the sums stolen daily did not amount to more than about £3 . . . . The fields were all measured, and the water carefully distributed for irrigation; taxes were imposed upon trade, and an income-tax levied from merchants and traders. Royal roads are spoken of by Strabo and mile-stones . . . Gold and gems, silks and ornaments were in all families; the professions mentioned show all that is necessary to civilised life. . . . The number of kinds of grains, spices, etc., which were grown afford proofs that the country was in a high state of cultivation. . . . Their internal institutions were less rude; their conduct to their enemies more humane; their general learning much more considerable; and, in the knowledge of the being and nature of God, they were already in possession of a light which was but faintly perceived, even by the loftiest intellects in the best days of Athens."—(*History of India*, page 52.)

The author of the "Periplus of the Erythrian Sea" fully describes Indian commodities for which there was a great demand in the West, especially at Rome, about the first century of Christ. Many a traveller from the West has similarly described the trade of India. In the fourth and the sixth centuries two Chinese travellers visited India, and have fully recorded their views on its material condition, which included flourishing arts and industries.

Then came the period of the Crusades and the first beginning of the Levantine trade which culminated in Venice becoming the greatest trader with India; and later on, Genoa. Marco Polo came here in the thirteenth century, and he also has left a record of his impressions.

The waves of conquest which commenced from the eleventh century no doubt greatly hampered Indian industrialists and industries for some time.

But the establishment of the Moghal Empire and the safety and security of the reign of Akbar seem to have fully revived Indian industries and handicrafts. Bernier, who visited India in the reign of Shahjahan, gives a glowing description of his capital. He speaks of his immense treasures, gold and silver and jewellery, "a prodigious quantity of pearls and precious stones of all sorts" . . . and marvels over the incredible quantity of manufactured goods. "Embroideries, streaked silks, tufts of gold turbans, silver and gold cloth, brocades, net-work of gold," etc. . . . Tavernier also gives a long description of the manufactured goods, and dwells with wonder on the "marvellous peacock-throne, with the natural colours of the peacock's tail worked out in jewels, of carpets of silk and gold, satins with streaks of gold and silver, endless lists of exquisite works, of minute carvings, and other choice objects of art."

The East India Company.

It was this trade and prosperity that lured the traders of Europe to India. As the historian Murray puts it:—"Its fabrics, the most beautiful that human art has anywhere produced, were sought by merchants at the expense of the greatest toils and dangers." (*History of India*, page 27.) After the decline of Venice and Genoa, the Portuguese and the Dutch captured the Indian trade. The merchants of England viewed their trade with envious eyes, and formed the East India Company which obtained its charter from Queen Elizabeth on 31st December 1600, to trade with the East Indies, not "to exchange as far as possible the manufactured goods of England for the products of India" (Report para. 2)—for there were few English manufactures then to be exported—but to carry the manufactures and commodities of India to Europe.

"At the end of the seventeenth century," says Lecky, "great quantities of cheap and graceful Indian calicoes, muslins and chintzes were imported into England, and they found such favour that the woollen and silk manufacturers were seriously alarmed. Acts of Parliament were accordingly passed in 1700 and in 1721 absolutely prohibiting, with a very few specified exceptions, the employment of printed or dyed calicoes in England, either in dress or in furniture, and the use of any printed or dyed goods, of which cotton formed any part."—(Lecky's *History of England in the Eighteenth Century.*)

When Clive entered Murshidabad, the old capital of Bengal, in 1757, he wrote of it:—

"This city is as extensive, populous and rich as the city of London, with this difference that there were individuals in the first possessing infinitely greater property than in the last city."—(H. J. S. Cotton, in *New India*, published before 1890.)

"Less than a hundred years ago," wrote Sir Henry Cotton in 1890, "the whole commerce of Dacca was estimated at one crore of rupees, and its population at 200,000 souls. In 1787 the exports of Dacca muslin to England amounted to 30 lakhs of rupees; in 1817 they had ceased altogether. The arts of spinning and weaving, which for ages afforded employment to a numerous and industrial population, have now become extinct. Families which were formerly in a state of affluence have been driven to desert the town and betake themselves to the villages for a livelihood. The present population of the town of Dacca is only 79,000. This decadence has occurred not in Dacca only, but in all districts. Not a year passes in which the Commissioners and District Officers do not bring to the notice of Government that the manufacturing classes in all parts of the country are becoming impoverished."

"In the first four years of the nineteenth century," says Mr. Romesh Chandra Dutta, "in spite of all prohibitions and restrictive duties, six to fifteen thousand bales of cotton piece-goods were annually shipped from Calcutta to the United Kingdom. The figure rapidly fell down to 1813. The opening of trade to private merchants in that year caused a sudden rise in 1815; but the increase was temporary. After 1820 the manufacture and export of cotton piece-goods declined steadily; never to rise again."—(*Economic History of British India*, page 296.)

How India came to be an Agricultural Country.

At an early period of the Company's administration, British weavers had begun to be jealous of the Bengal weavers, whose silk fabrics were imported into England, and so not only were Indian manufactures shut out from England, but—

> "a deliberate endeavour was now made to use the political power obtained by the East India Company," says Mr. Romesh Dutta, "to discourage the manufactures of India. In their letter to Bengal, dated 17th March, 1769, the Company desired that the manufacture of raw silk should be encouraged in Bengal, and that of manufactured silk fabrics should be discouraged. And they also recommended that the silk winders should be forced to work in the Company's factories and prohibited from working in their own homes."

In a letter of the Court of Directors, quoted in Appendix 37 to the Ninth Report of the House of Commons Select Committee on the Administration of Justice in India 1783, (quoted by Mr. Romesh Dutta at page 45 of his book), it was stated:—

> "This regulation seems to have been productive of very good effects, particularly in bringing over the winders, who were formerly so employed, to work in the factories. Should this practice (the winders working in their own homes) through inattention have been suffered to take place again, it will be proper to put a stop to it, which may now be more effectually done, by an absolute prohibition, under severe penalties, by the authority of the Government."

> "This letter," as the Select Committee justly remarked, "contains a perfect plan of policy, both of compulsion and encouragement, which must in a very considerable degree operate destructively to the manufactures of Bengal. Its effects must be (so far as it could operate without being eluded) to change the whole face of the industrial country, in order to render it a field for the produce of crude materials subservient to the manufactures of Great Britain."—(*Ibid*).

Furthermore, according to Mr. Digby, in 1813, Indian cotton manufactures were liable to the following charges in England:—

	£	*s.*	*d.*
Calicoes or dimities for every £100 of value	81	2	11
Cotton, raw (per 100 lbs.)	0	16	11
Cotton, manufactured	81	2	11
Hair or goat's wool, manufactures of, per cent. . . .	84	6	3
Flowered or stitched muslins of white calicoes (for every £100 in value)	32	9	2
Other manufactures of cotton not otherwise charged . .	32	9	2

"These burdensome charges were subsequently removed, but only after the export trade in them had, temporarily or permanently, been destroyed." (*Prosperous British India*, page 90.) On the other hand, ever since English power was established in India, English goods entered India either with no import, or with a merely nominal import duty. At the time Indian cotton goods were liable to the heavy duty of £81 per cent. in England, English cotton goods imported into India were subject to a duty of only 2½ per cent. In addition to this, the steam engine and the power loom had in the meantime been perfected in England, and English manufactures had begun to come in increasing quantities to India. The result was well described by Mr. Henry St. George Tucker, who had, on retirement from India, become a Director of the East India Company. Writing in 1823, he said:—

> "The silk manufactures (of India) and its piece-goods made of silk and cotton intermixed, have long since been excluded altogether from our markets; and of late, partly in consequence of the operation of a duty of 67 per cent., but chiefly from the effect of superior machinery, the cotton fabrics which heretofore constituted the staple of India,

have not only been displaced in this country, but we actually export our cotton manufactures to supply a part of the consumption of our Asiatic possessions. India is thus reduced from the state of a manufacturing to that of an agricultural country."—(*Memorials of the Indian Government;* being a selection from the papers of Henry St. George Tucker (London 1853) page 494, quoted by Mr. Romesh Dutta at page 262 of his *Economic History of British India.*)

H. H. Wilson, the historian of India, also wrote as follows :—

> "It was stated in evidence (in 1813) that the cotton and silk goods of India up to the period could be sold for a profit in the British market at a price from 50 to 60 per cent. lower than those fabricated in England. It consequently became necessary to protect the latter by duties of 70 and 80 per cent. on their value, or by positive prohibition. Had this not been the case, had not such prohibitory duties and decrees existed, the mills of Paisley and Manchester would have stopped in their outset, and could scarcely have been again set in motion, even by the power of steam. They were created by the sacrifice of the Indian manufacture. Had India been independent, she would have retaliated, would have imposed prohibitive duties upon British goods, and would thus have preserved her own productive industry from annihilation. This act of self-defence was not permitted her; she was at the mercy of the stranger. British goods were forced upon her without paying any duty, and the foreign manufacturer employed the arm of political injustice to keep down and ultimately strangle a competitor with whom he could not have contended on equal terms."—(Quoted by Romesh Dutta, *Ibid,* pages 262-263.)

Another important Indian industry which succumbed to the jealousy of English manufacturers, was ship-building. That ship-building was an ancient industry in India, and that Indians carried on navigation to far distant climes east and west, has been fully established by Dr. Radhakumud Mukerjee in his valuable "History of Indian Shipping." Both Darius and Alexander had hundreds of vessels constructed in India. Indian rivercraft navigated Africa and went as far as Mexico. Again from the Coromandel coast Indians navigated as far as Java, Sumatra, Borneo and distant Canton. "A hundred years ago," says Mr. Digby, "ship-building was in so excellent a condition in India that ships could be (and were) built which sailed to the Thames in company with British-built ships and under the convoy of British frigates."

The Governor-General (Lord Wellesley) reporting in 1800 to his masters in Leadenhall Street, London, said :—

> "The port of Calcutta contains about 10,000 tons of shipping, built in India, of a description calculated for the conveyance of cargoes to England . . . From the quantity of private tonnage now at command in the port of Calcutta, from the state of perfection which the art of ship-building has already attained in Bengal (promising a still more rapid progress and supported by abundant and increasing supplies of timber), it is certain that this port will always be able to furnish tonnage, to whatever extent may be required, for conveying to the port of London the trade of the private British merchants of Bengal."—(Quoted by Mr. Digby in *Prosperous British India,* page 86.)

But, says Mr. Taylor :—

> "The arrival in the port of London of Indian produce in Indian-built ships created a sensation among the monopolists which could not have been exceeded if a hostile fleet had appeared in the Thames. The ship-builders of the port of London took the lead in raising the cry of alarm; they declared that their business was on the point of ruin, and that the families of all the shipwrights in England were certain to be reduced to starvation."—(*History of India,* page 216.)

The cry prevailed. The Court of Directors opposed the employment of Indian ships in the trade between England and India. In doing so, says Mr. Digby, they employed an argument which, in some of its terms, sounds very curious at the present time, when so many lascars are employed by all the great lines of steamers running to the East. After reciting other reason against ship-building and ship-manning in India, the Court said in their despatch, dated 27th January, 1801:—

> "XVII. Besides these objections which apply to the measure generally, there is one that lies particularly against ships whose voyages commence from India, that they will usually be manned in great part with lascars or Indian sailors. Men of that race are not by their physical frame and constitution fitted for the navigation of cold and boisterous latitudes; their nature and habits are formed to a warm climate, and short and easy voyages performed within the sphere of periodical winds; they have not strength enough of mind or body to encounter the hardships or perils to which ships are liable in the long and various navigation between India and Europe, especially in the winter storms of our northern seas, nor have they the courage which can be relied on for steady defence against an enemy . . . But this is not all. The native sailors of India are . . . on their arrival here, led into scenes which soon divest them of the respect and awe they had entertained in India for the European character. . . . The contemptuous reports which they disseminate on their return cannot fail to have a very unfavourable influence upon the minds of our Asiatic subjects, whose reverence for our character, which has hitherto contributed to maintain our supremacy in the East, will be gradually changed . . . and the effects of it may prove extremely detrimental. . . . Considered, therefore, in a physical, moral, commercial, and political view, the apparent consequences of admitting these Indian sailors largely into our navigation, form a strong additional objection to the concession of the proposed privilege to any ship manned by them."—(Appendix No. 47—Supplement to Fourth Report, East India Company, pages 23-24, quoted by Mr. Digby in *Prosperous British India,* at pages 101-103.)

The lascars of to-day are only the successors of those who emerged from the ports of Kathiawar and navigated from thence to Aden and Mocha to the East African coast and to the Malay Peninsula. It is possible an Indian lascar in the early nineteenth century, finding himself in London, may have indulged himself just as Jack to-day does, when he lands in any important Indian port. But it cannot but be regretted that such small considerations were allowed to weigh at all against Indian navigation to England. And it is difficult to express in words the economic and political losses which this attitude has meant for England as well as India. How much better would have been the position of India, how infinitely stronger that of England, if Indian shipping had been allowed to grow, and had grown as shipping in other countries has grown during the last forty years, and been available to India and the Empire in this hour of need.

Mr. Romesh Dutta has shown in his "Economic History of British India" that this continued to be the settled policy of England towards India for fifty years and more; that it was openly avowed before the House of Commons and vigorously pursued till 1833 and later; and that it effectually stamped out many of the national industries of India for the benefit of English manufactures. Mr. Arnold Toynbee has expressed the same view:—

> "English industries would not have advanced so rapidly without protection, but the system, once established, led to perpetual wrangling on the part of rival industries, and sacrificed India and the Colonies to our great manufactures."—(*The Industrial Revolution of the Eighteenth Century in England,* by Arnold Toynbee, page 58.)

English Industrial Revolution.

Let us now turn to England to see what happened there during the same period. The industrial revolution, which has powerfully affected Indian industries, is said to have begun in England in 1770.

> "In 1770," says Mr. Cunningham, "there was no Black Country, blighted by the conjunction of coal and iron trades; there were no canals or railways, and no factory towns with their masses of population. All the familiar features of our modern life, and all its most pressing problems, have come to the front within the last century and a quarter."—(*The Growth of English Industry and Commerce,* by W. Cunningham, Part II, page 613.)

Up to the middle of the eighteenth century English industry was in a very backward condition. The state of that industry is thus described by John Richard Green:—

> "Though England already stood in the first rank of commercial states at the accession of George the Third, her industrial life at home was mainly agricultural. The wool trade had gradually established itself in Norfolk, the West Riding of Yorkshire and the countries of the south west; while the manufacture of cotton was still almost limited to Manchester and Bolton, and remained so unimportant that in the middle of the eighteenth century the export of cotton goods hardly reached the value of fifty thousand a year. There was the same slow and steady progress in the linen trade of Belfast and Dundee and the silks of Spitalfields. The processes of manufacture were too rude to allow any large increase of production . . . But had the processes of manufacture been more efficient, they would have been rendered useless by the want of a cheap and easy means of transport. The older main roads had broken down. The new lines of trade lay often along mere country lanes which had never been more than horse-tracks . . . A new era began when the engineering genius of Brindley joined Manchester with its port of Liverpool in 1767 by a canal; the success of the experiment soon led to the universal introduction of water-carriage, and Great Britain was traversed in every direction by three thousand miles of navigable canals. At the same time the new importance was given to coal which lay beneath the soil of England. The stores of iron which had lain side by side with it in the northern countries had lain there unworked through the scarcity of wood, which was looked upon as the only fuel by which it could be smelted. In the middle of the eighteenth century a process for smelting iron with coal turned out to be effective; and the whole aspect of the iron trade was at once revolutionised. Iron was to become the working material of the modern world; and it is its production of iron which more than all else has placed England at the head of industrial Europe. The value of coal as a means of producing mechanical force was revealed in the discovery by which Watt in 1766 transformed the steam engine from a mere toy into the most wonderful instrument which human industry has ever had at its command . . . Three successive inventions in twelve years, that of the spinning jenny in 1764 by the weaver Hargreaves, of the spinning machine in 1768 by the barber Arkwright, of the 'mule' by the weaver Crompton in 1776, were followed by the discovery of the power loom. But these would have been comparatively useless had it not been for the revelation of a new inexhaustible labour-force in the steam engine. It was the combination of such a force, with such means of applying it, that enabled Britain during the terrible years of her struggle with France and Napoleon to all but monopolize the woollen and cotton trades, and raised her into the greatest manufacturing country that the world had seen."—(Green's *Short History of the English People,* pages 791-92.)

But as Mr. Cunningham has pointed out:—

> "Inventions and discoveries often seem to be merely fortuitous; men are apt to regard the new machinery as the outcome of a special and unaccountable burst of inventive genius in the eighteenth century. But . . . to point out that Arkwright and Watt were fortunate in the fact that the times were ripe for them, is not to detract from their merits. There had been many ingenious men from the time of Willam Lee and Dodo Dudley; but the conditions of their day were unfavourable to their success. The introduction of expensive implements, or processes, involves a large outlay; it is not worth while for any man, however energetic, to make the attempt, unless he has a considerable command of capital, and has access to large markets. In the eighteenth century these conditions were being more and more realised. The institution of the Bank of England, and of other Banks, had given a great impulse to the formation of capital; and it was much more possible than it had ever been before for a capable man to obtain the means of introducing costly improvements in the management of his business."—(*Growth of English Industry and Commerce,* Part II, page 610.)

The Bank of England had been formed in 1694 as an instrument for procuring loans from the people at large by the formal pledge of the State to repay the money advanced on the demand of the lender.

> "But for more than sixty years after the foundation of the bank, its smallest note had been for £20, a note too large to circulate freely, and which rarely travelled far from Lombard Street. Writing in 1790, Burke said that when he came to England in 1750, there were not

'twelve bankers' shops' in the provinces, though then (in 1790) he said, they were in every market town. Thus, the arrival of the Bengal silver not only increased the mass of money, but stimulated its movement; for at once, in 1759, the bank issued £10 and £15 notes, and in the country private firms poured forth a flood of paper."—(Brooks Adams *The Law of Civilization and Decay*, pages 263-264—quoted by Mr. Digby at page 33 of his book.)

> "In 1756, when Clive went to India, the nation owed £74,575,000, on which it paid an interest of £2,753,000. In 1815 this debt had swelled to £861,000,000, with an annual interest charge of £32,645,000." (*Ibid*, page 33) . . . "The influx of the Indian treasure, by adding considerably to the nation's cash capital, not only increased its stock of energy, but added much to its flexibility and the rapidity of its movement." (*Ibid*, page 31.) . . . "Very soon after Plassey, the Bengal plunder began to arrive in London, and the effect appears to have been instantaneous, for all authorities agree that the 'industrial revolution,' the event which has divided the nineteenth century from all antecedent time, began with the year 1760. Prior to 1760, according to Baines, the machinery used for spinning cotton in Lancashire was almost as simple as in India; while about 1750 the English iron industry was in full decline because of the destruction of the forests for fuel. At that time four-fifths of the iron used in the kingdom came from Sweden."

> "Plassey was fought in 1757, and probably nothing has ever equalled the rapidity of the change which followed. In 1760 the flying-shuttle appeared, and coal began to replace wood in smelting. In 1764 Hargreaves invented the spinning jenny, in 1779 Crompton contrived the mule, in 1785 Cartwright patented the power loom, and chief of all, in 1768 Watt matured the steam engine, the most perfect of all vents of centralising energy. But, though those machines served as outlets for the accelerating movement of the time, they did not cause the acceleration. In themselves inventions are passive, many of the most important having lain dormant for centuries, waiting for a sufficient store of force to have accumulated to set them working. That store must always take the shape of money, and money not hoarded, but in motion."—(Brooks Adams *The Law of Civilization and Decay*, pages 259-260.)

Money came from India. Mr. Digby says in his "Prosperous British India":—

> "England's industrial supremacy owes its origin to the vast hoards of Bengal and the Karnatik being made available for her use . . . Before Plassey was fought and won, and before the stream of treasure began to flow to England, the industries of our country were at a very low ebb. Lancashire spinning and weaving were on a par with the corresponding industry in India so far as machinery was concerned; but the skill which had made Indian cottons a marvel of manufacture was wholly wanting in any of the Western nations. As with cotton so with iron; industry in Britain was at a very low ebb, alike in mining and in manufacture."—(*Ibid*, pages 30-31).

Though the power loom was constructed in 1784, power weaving did not become a practical success until the dressing-frame was invented in 1803. Up to 1801, the cotton goods sent out from England to India amounted in value to £21,000; by 1813 they had risen to £108,824. When the charter of the East India Company was renewed in that year, its monopoly of trade with India was abolished, and British traders obtained a fresh outlet into this extensive Empire. The enormous increase of the imports of English manufactured cottons into India in subsequent years hardly needs description. By the end of the century, India had become the largest single market for them, its demands for British cotton goods having been just under £20,000,000. In the year before the war they had risen to £44,581,000.

Effects of Exports of Raw Produce.

Another factor which has powerfully contributed to India becoming more and more agricultural is the policy pursued by the British Government in India of encouraging the exports of its raw produce. Paragraph 5 of our Report has discussed the effects of these exports and that of the advent of the railway and the steamship. But it seems to me that, for an adequate appreciation of the results, the matter requires to be treated at greater length.

In the eighteenth century the Colonies of England were looked upon as "plantations" where raw produce was grown to be sent to the mother country, to be manufactured and sent back to the Colonies and to the rest of the world. After the American War of Independence the new Colonies were allowed to work out their own destinies, and they began to develope their manufacturing power by protection even against British manufactures. Since then, in the expressive language of Mr. Ranade:—

> "The great Indian Dependency of England has come to supply the place of the old Colonies. This Dependency has come to be regarded as a Plantation, growing raw produce to be shipped by British agents in British ships, to be worked into Fabrics by British skill and capital, and to be re-exported to the Dependency by British merchants to their corresponding British Firms in India and elsewhere."—(*Essays*, page 99.)

This is best illustrated by the case of cotton. The Court of Directors of the East India Company began so early as 1788 to take an interest in the question of the cultivation of cotton in India, and expended considerable sums in various attempts to stimulate its growth. Since 1858, the Government of India have, at the instance of British manufacturing interests, taken steps from time to time to improve the quality and quantity of cotton produced in India. The latest evidence of this is the appointment of the Indian Cotton Committee of last year. I do not complain that this has been done. On the contrary, I think enough has not been done in this direction. I think India can grow, and ought to be helped to grow, much more and better cotton, and should be able to help both England and herself with it. But my point is that the policy which the Government has hitherto pursued has been one of encouraging the exports of raw produce. Its policy has not been to encourage the conversion of our raw cotton into manufactures. The doctrines of free trade and of *laissez faire*, and an undue regard for English interests and the fear of interference with English trade, have prescribed the policy which it has had to pursue.

Railways and Commerce.

The construction of railways in India was mooted by the first Lord Hardinge. He left a minute in 1848, and his successor, Lord Dalhousie, took up the subject. It was in 1853 that Lord Dalhousie wrote his great Railway minute and gave the first stimulus to railway construction. India is indebted to him for the railway, as also for the telegraph. Says his eminent biographer, Sir William Hunter :—

> "This was Lord Dalhousie's masterly idea—not only would he consolidate the newly annexed territories of India by his railways, and immensely increase the striking power of his military forces at every point of the Empire, but he would use a railway construction as a bait to bring British capital and enterprise to India on a scale which had never entered the imagination of any previous Governor-General.
>
> "In all these arrangements," continues Sir William Hunter, "Lord Dalhousie had from the outset a vigilant eye to the mercantile aspects of his railway routes. 'The commercial and social advantages,' he wrote in his masterly minute on railways, 'which India would derive from their establishment are, I truly believe, beyond all present calculation. Great tracts are teeming with produce they cannot dispose of. Others are scantily bearing what they would carry in abundance, if only it could be conveyed whither it is needed. England is calling aloud for the cotton which India does already produce in some degree, and would produce sufficient in quality, and plentiful in quantity, if only there were provided the fitting means of conveyance for it from distant plains to the several parts adopted for its shipment. Every increase of facilities for trade has been attended, as we have seen, with an increased demand for articles of European produce in the most distant markets of India; and we have

yet to learn the extent and value of the interchange which may be established with people beyond our present frontier, and which is yearly and rapidly increasing. Ships from every part of the world crowd our ports in search of produce which we have, or could obtain in the interior, but which at present we cannot profitably fetch thence; and new markets are opening to us on this side of the globe under circumstances which defy the foresight of the wisest to estimate their probable value or calculate their future extent.'

"Lord Dalhousie provided free play for the mercantile possibilities of the railways by removing the previous checks and hindrances on Indian trade. Sir Edwin Arnold sums up these measures in a pithy marginal note :—'All ports in India made free.'

"The unprecedented impulse which Lord Dalhousie thus gave to Indian trade may be realized by the following figures. During his eight years of rule the export of raw cotton more than doubled itself from 1½ millions sterling to close on 3½ millions. The export of grain multiplied by more than threefold from £890,000 in 1848 to £2,900,000 in 1856. . . . The total exports of merchandise rose from 13⅓ millions sterling in 1848 to over 23 millions in 1856.

"The vast increase of productive industry, represented by these figures, enabled the Indian population to purchase the manufactures of England on an unprecedented scale. The imports of cotton goods and twist into India rose from three millions sterling in 1848 to 6⅓ millions in 1856. The total imports of merchandise and treasure increased during the eight years from 10½ to 25¼ millions."—(*Dalhousie,* Rulers of India Series, by Sir W. W. Hunter, pages 191, 193-196).

I am fully alive to the advantages which railways have conferred on India. I have quoted from Sir William Hunter to show how their introduction affected Indian industries. As Lord Dalhousie's minute shows, one of the objects which they were intended to serve was the promotion of English trade and commerce with India. That was then the policy of the Government. I do regret that it was not then also the policy of Government to promote Indian industries, for then India would have prospered as well as England. It is particularly to be regretted that when they decided to develope a vast system of railways in India, they did not also decide to develope the iron and steel industry. For if they had done so, there would have been a much greater and more rapid extension of railways, because they would have cost India much less—according to official testimony, the price of iron was increased fifty per cent., by reason of freight and landing charges—and would have spelled much greater benefits to the country than they have. The adoption of such a policy had been urged long ago both by Indians and by Englishmen. In a paper which he read before the Industrial Conference at Poona in 1893, Mr. Ranade said :—

"Many years ago Captain Townsend of the Ordnance Department observed in his work on the Mineral Wealth of India that nothing strikes the stranger who studies Indian economy so much as the contrast between the bounty of Nature and the poverty of Man in the matter of this iron industry. Endowed more richly in iron ore than almost any other country in the world, India has in a commercial sense, no iron industry at all."—(*Essays,* pages 158-159.)

"Mr. Ball, Deputy Superintendent of the Geological Survey, in his work on Economic Geology observes that if the Government had started the manufacture of iron on an extended scale at the time of the first opening of the railways, great benefits would have accrued to the State. If the State was justified in undertaking the construction of its own railways, there was nothing inconsistent with principle in its undertaking the manufacture of its own iron any more than in its manufacture of salt or opium. The effect of its establishing factories for iron manufacture throughout India would have, in Mr. Ball's opinion, enabled the State to keep vast sums of money in circulation, and would have given employment to large numbers of people who now resort to agriculture as their only resource. The golden opportunity was allowed to pass, and we find ourselves in the anomalous situation that after one hundred and fifty years of British rule, the iron resources of India remain undeveloped, and the country pays about ten * crores of rupees yearly for its iron supply, while the old race of iron smelters find their occupation gone."—(*Essays,* pages 164-165.)

That this could have been done is proved by the success of the great Tata Iron and Steel Works. The Government have earned the gratitude of Indians by the support they gave to the scheme, and it is a matter of great satisfaction that the firm has rendered signal services to the Government and the Empire during this war by a ready supply of rails and shell steel for use in Mesopotamia and Egypt. But if the Government had taken up the question of the manufacture of iron and steel when the schemes of railways were projected, or even later, the industry would have been established in the country much earlier and the entire industrial prospect of the country would have been altered and improved. It was not done, because, unfortunately for India, it was not the policy of the Government then to promote Indian industries.

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* The value of these imports had risen by 1913-14 to 25 crores.

I have dwelt at some length upon these facts to remind my English fellow-subjects how largely England is indebted for her "industrial efficiency" and prosperity to her connection with India, and how grave an economic wrong has been done to India by the policy pursued in the past, with the object that this should induce them the more to advocate and insist upon a truly liberal policy towards India in the future. I have also done this to dispel the idea that Indians are to blame for the decline of their indigenous industries, or that they suffer from any inherent want of capacity for industrial development on modern lines, and that Europeans are by nature more fitted than Asiatics for success in manufacturing pursuits. I have shown that up to the middle of the eighteenth century England herself was an agricultural country; that for thousands of years and up to the beginning of the last century, India excelled in manufactures as well as in agriculture, and that if during the century she came to be predominantly agricultural, this was due to the special treatment to which she had been subjected and not to any want of industrial capacity and enterprise among her people.

The Result—Frequent Famines.

The decline of Indian industries, the growing imports of British manufactures and the exports of raw produce from India, led inevitably to the impoverishment of the manufacturing classes in all parts of the country and drove a growing proportion of the population to depend more and more upon the land. Out of a total record export of 58¾ millions in 1878-9, only 6½ per cent. represented the value of what could properly be called manufactured goods, 93½ per cent. being mere raw produce. In 1880 the imports of manufactured goods were valued at £51,397,561. By the combined operation of these two causes the country was reduced to an economic condition which exposed it to the aggravated evils of frequent famines. Sir Horace Plunkett, whose inability to join us I most sincerely regret, pointed out in his valuable Report of the Recess Committee of 1896, that similar causes had led at an earlier period to similar results in Ireland. Speaking of the effect of legislation which had struck at all Irish industries, not excepting agriculture, he said:—

> "It forced the population into entire dependence on the land and reduced the country to an economic condition involving periodical famines."

In India there were five famines between 1800 to 1825; two between 1825 to 1850; six between 1851 to 1875; eighteen between 1876 to 1900. According to Mr. Digby, the total mortality, according to official records, between 1854 to 1901 was 28,825,000. Writing in 1901, Mr. Digby said:—

> "Stated roughly, famines and scarcities have been four times as numerous during the last thirty years of the nineteenth century as they were one hundred years earlier, and four times more widespread."

I agree with my colleagues that, apart from the other advantages which railways have conferred upon India, they have had an important effect in lessening the disastrous results of famines. Grain can be carried to tracts affected by famine with much greater ease now than could be done before, and deaths from actual unavailability of food can be prevented. Since 1900, when the second Famine Commission, over which Sir Antony (now Lord) MacDonnell presided, made its report, the problem of famine relief and famine administration has also been placed on a satisfactory basis, and an admirable Famine Code has been drawn up. "In regard to palliatives much has been done; but in respect of prevention, the hand has been slack." And this, I regret to say, notwithstanding the fact that many of the remedies which we recommend to-day were recommended nearly forty years ago.

After the disastrous famine of 1877-1878, the Government was pleased to appoint an Indian Famine Commission to enquire "how far it is possible for Government by its action, to diminish the severity of famines, or to place the people in a better condition for enduring them." In their Report the Commission said:—

> "A main cause of the disastrous consequences of Indian famines, and one of the greatest difficulties in the way of providing relief in an effectual shape is to be found in the fact that the great mass of the people directly depend on agriculture, and that there is no other industry from which any considerable part of the population derives its support. The failure of the usual rains thus deprives the labouring class, as a whole, not only of the ordinary supplies of food obtainable at prices within their reach, but also of the sole employment by which they can earn the means of procuring it. The complete remedy for this condition of things will be found only in the development of industries other than agriculture and independent of the fluctuations of the seasons."

The principal recommendations which that Commission made for the "encouragement of a diversity of occupations" among the people, are so valuable, and so much in line with many of our own recommendations, that I reproduce them below. They said:—

> "1. We have elsewhere expressed our opinion that at the root of much of the poverty of the people of India, and of the risks to which they are exposed in seasons of scarcity, lies the unfortunate circumstance that agriculture forms almost the sole occupation of the mass of the population, and that no remedy for present evils can be complete which does not include the introduction of a diversity of occupations, through which the surplus population may be drawn from agricultural pursuits and led to find the means of subsistence in manufactures or some such employments."

And, after referring to the obstacles that then stood in the way of the investment of English capital in India, and after urging reasons why direct State aid could not then be given, they proceeded to say:—

> "6. There are, however, directions in which we have no doubt the Government might usefully aid in fostering the inception of new industries. The introduction of tea cultivation and manufacture is an instance of the successful action of the Government which should encourage further measures of a like character. In this case, the Government started plantations, imported Chinese workmen, distributed seed, and brought the industry into a condition in which its commercial success was no longer doubtful. It then retired from any share in it, sold its plantations, and left the field to private capitalists. The cultivation of cinchona is a measure of a somewhat similar description though it has not yet passed entirely into the hands of private persons.
>
> "7. In treating of the improvement of agriculture, we have indicated how we think the more scientific methods of Europe may be brought into practical operation in India by the help of specially trained experts, and the same general system may, we believe, be applied with success both to the actual operations of agriculture and to the preparation for the market of the raw agricultural staples of the country. Nor does there appear any reason why action of this sort should stop at agricultural produce, and should not be extended to the manufactures which India now produces on a small scale or in a rude form, and which, with some improvement, might be expected to find enlarged sales, or could take the place of similar articles now imported from foreign countries.

"8. Among the articles and processes to which these remarks would apply may be named the manufacture and refining of sugar; the tanning of hides; the manufacture of fabrics of cotton, wool and silk; the preparation of fibres of other sorts, and of tobacco; the manufactures of paper, pottery, glass, soap, oils and candles.

"9. Some of these arts are already practised with success at Government establishments, such as the tannery at Cawnpur, which largely supplies harness for the army, and the carpet and other manufactures carried on in some of the larger jails; and these institutions form a nucleus, around which we may hope to see a gradual spread of similar industry. They afford practical evidence of the success of the arts practised, and are schools for training the people of the country in improved methods; and so long as any such institutions fairly supply a Government want, which cannot be properly met otherwise, or carry on an art in an improved form, and therefore guide and educate private trade, their influence can hardly fail to be beneficial. The same may be said of the workshops of the Government and the railway companies, which are essential for the special purposes for which they are kept up, and gradually train and disseminate a more skilled class of artizans.

"10. The Government might further often afford valuable and legitimate assistance to private persons desiring to embark in a new local industry, or to develope and improve one already existing, by obtaining needful information from other countries or skilled workmen or supervision, and at the outset supplying such aid at the public cost. So far as the products of any industries established in India can be economically used by the Government, they might properly be preferred to articles imported from Europe, and generally the local markets should be resorted to for all requisite supplies that they can afford. We are aware that steps have been taken within the last few years to enforce these principles, but more can certainly be done, and greater attention may properly be paid to the subject.

"11. Otherwise than as above indicated, we do not think it desirable that the Government should directly embark in any manufacture or industry in an experimental way. Such experiments to be really successful or valuable must be carried out on a commercial basis. The conditions of any Government undertaking are rarely such as to give it this character, and the fear of incurring an undue expenditure on what is regarded as only an experiment will often lead to failure, which will be none the less mischievous because it was thus caused.

"12. There is no reason to doubt that the action of Government may be of great value in forwarding technical, artistic, and scientific education, in holding out rewards for efforts in these directions, and in forming at convenient centres museums or collections by which the public taste is formed and information is diffused. The great industrial development of Europe in recent years has doubtless received no small stimulus from such agencies; and the duty of the Government in encouraging technical education is one to which the people of England are yearly becoming more alive, and which it is certain will be more adequately performed in the future. All the causes which render such action on the part of Governments desirable in Europe apply with greater force to India. Experience, however, is still wanting, even in England, as to how such instruction should be given, and for India it will be hardly possible at present to go beyond the training of ordinary workmen in the practice of mechanical or engineering manipulation.

"13. To whatever extent it is possible, however, the Government should give assistance to the development of industry in a legitimate manner, and without interfering with the free action of the general trading community, it being recognised that every new opening thus created attracts labour which would otherwise be employed to comparatively little purpose on the land, and thus sets up a new bulwark against the total prostration of the labour market, which in the present condition of the population follows on every severe drought."

The cry of Indians for the promotion of Technical Education and Indigenous Industries.

This valuable Report was published in 1880, but it seems that little heed was paid to its most important recommendations. Little was done to encourage indigenous industries; less to promote technical education. In the meantime the Indian National Congress, which was organised to focus Indian public opinion and to represent the wants and wishes of the Indian public to the

Government, came into existence in 1885. At its third session in 1887 it passed the following resolution :—

> "That having regard to the poverty of the people, it is desirable that the Government be moved to elaborate a system of technical education, suitable to the condition of the country, to encourage indigenous manufactures by a more strict observance of the orders, already existing, in regard to utilising such manufactures for State purposes, and to employ more extensively than at present the skill and talents of the people of the country."

At its next session, in 1888, the Congress urged the appointment of a mixed Commission to enquire into the industrial condition of the country as a preliminary to the introduction of a general system of technical education. It reiterated this request in 1891, 1892 and 1893. In 1894 it affirmed in the most emphatic manner the importance of increasing public expenditure on all branches of education, and the expediency of establishing technical schools and colleges. It repeated the same request in 1895. In 1896 when a famine had broken out in a more or less acute form throughout India, it again urged that "the true remedy against the recurrence of famine lies in the adoption of a policy which would enforce economy, husband the resources of the State, foster the development of indigenous and local arts and industries which have practically been extinguished, and help forward the introduction of modern arts and industries." In 1898 it again prayed "that having regard to the poverty of the people, and the decline of indigenous industries, the Government will introduce a more elaborate and efficient scheme of technical instruction, and set apart more funds for a better and more successful working of the same." In 1904 the Congress urged the establishment of at least one central fully equipped polytechnic institute in the country, with minor technical schools and colleges in different provinces, and repeated that prayer in 1905. In 1906 it urged that primary education should be made free, and gradually compulsory, all over the country, and that adequate provision should be made for technical education in the different provinces, having regard to local requirements. It reiterated the same prayer in 1908, 1909, 1910, 1911 and 1913. After the outbreak of the war in 1914, the Congress urged the Government to adopt immediate measures to organise and develope Indian industries. As the years rolled on, the need for industrial development was more and more keenly felt by Indians. Since 1905, an Indian Industrial Conference has met year after year, as an adjunct of the National Congress, and it repeatedly pressed upon Government the need for providing technical, industrial and commercial education throughout the country. It has also urged various other measures for the encouragement of indigenous industries. But neither the recommendations of the Indian Famine Commission nor the representations of the Indian National Congress, nor those of the Indian Industrial Conference, produced much effect. Speaking at the Industrial Conference convened by Government in 1907, Sir John Hewett, the then Lieutenant-Governor of the United Provinces, said :—

> "The question of technical and industrial education has been before the Government and the public for over twenty years. There is probably no subject on which more has been written or said, while less has been accomplished."

The earlier portion of Chapter X of our Report, dealing with industrial education, shows how little has been done up to this time to provide such education for the people. A few years ago the Government of India instituted scholarships of the annual value of £150, not exceeding ten in number, to enable Indians to proceed to Europe and America for special training, but it was not necessarily to be technical. Under this system 100 students have hitherto gone abroad for such training. Finding the provision to promote the scientific and industrial education of Indians in the country wholly insufficient, a few Indian and European gentlemen started an Association in Calcutta in 1904, one of the objects of which was 'to enable distinguished graduates of Indian Universities to prosecute further studies in science in Europe, America, Japan or other foreign countries.' Since 1910 the Bengal Government helped the Association with an annual grant of Rs. 5,000, which has been reduced to Rs. 2,500 since the war. Rai Jogendra Chandra Ghose Bahadur, Secretary of the Association, told us that over 300 students had been sent abroad with the assistance of this Association for such education, and that 140 of them had returned, of whom 130 were employed. He also told us that his students have started twenty new factories and were in charge of several factories employing a capital of over forty lakhs of rupees. This shows how keen is the desire of Indians to obtain technical education and to devote themselves to the industrial regeneration of their country. The Government of India have recently increased the number of technical scholarships to thirty, and have revised the rules regulating the grant of such scholarships, which are in some respects an improvement on those they have superseded. But these scholarships are too few to meet the requirements of the situation. Adequate provision for imparting useful industrial and technical education both at home and abroad, remains yet to be made for the youth of India.

Progress of other Nations in Manufactures, and its Effect on India.

Reference has been made in Chapters II, VI and VII of our Report to the growth of certain industries in India during recent years with Indian capital and Indian control, the most important among them being the cotton mill industry, the Tata Iron and Steel Works and the Tata Hydro-Electric Works. So far as this goes, this is a matter of sincere satisfaction. But the progress is altogether small. In the meantime, since 1870, other nations have made enormous progress in manufacturing industries. I would particularly mention Germany, Austria, the United States and Japan, as their progress has specially affected India. They have each done so by devising and carrying out a system of general and technical education for their peoples, accompanied by a system of State aid and encouragement of industries. And these nations—and several others besides—most of which have built up their industries by some form of State aid or protection, have taken full advantage of the policy of free trade to which India has been subjected, to purchase raw produce from India and to flood her markets with their manufactured goods. India has thus been exposed to ever-extending commercial subjugation by these nations, without being armed and equipped to offer a resistance and without being protected by any fiscal walls or ramparts. This incessant and long-continued attack has affected her agricultural as well as manufacturing industries. Her indigo industry has nearly been killed by Germany. Before 1897, when Dr. Bayer produced artificial indigo, Germany had been importing vegetable indigo of the value of over one million sterling. A few years afterwards she was exporting artificial indigo of three times that value. Germany's bounty-fed beet sugar gave the first serious shock to the ancient sugar industry of India, and it has suffered and is continually suffering from the competition of foreign sugar. In 1913-14 Germany and Austria purchased from India raw materials amounting to £24,220,400 in value or just a little less than one-sixth of the total output, while the imports to India from these two countries amounted to £11,304,141. The exports to the United Kingdom in the same year amounted to £38,236,780, and the imports from the United Kingdom to £78,388,149.

Forty or fifty years ago, Japan was far behind India both in agriculture and industries. But her Government and people, working in conjunction, have brought about a wonderful development of her industries built upon 'a system of technical education which included everything required to enable her to occupy her proper place among the manufacturing nations of the world.' Japan takes in a large proportion of the exports of our cotton, and she sends us an increasing quantity of her cotton goods and other manufactures. The average of her total imports of the five pre-war years 1909-10 to 1913-14 was 2·5 per cent. of our total imports. The share of her imports in the year ending March 1917, was 8·9 per cent. of the total. The total imports of India (excluding £28,959,766 of treasure, but including Government stores) amounted, in the year ending 31st March 1914, to £127,538,638. In the imports of the five pre-war years 1909-10 to 1913-14, the average share of the United Kingdom was 62·8 per cent.; of the other parts of the British Empire, 7 per cent.; of the allies (excluding Japan), 4·6 per cent.; of Japan, 2·5 per cent.; of the United States, 3·1 per cent.; of Java, 6·4 per cent.; and of the other foreign countries (principally Germany and Austria-Hungary), 13·6 per cent. The share of the principal countries in the imports of the year ending 31st March 1917, was the United Kingdom, 58·7 per cent.; other parts of the British Empire, 7 per cent.; allies (excluding Japan), 3·3 per cent.; Japan, 8·9 per cent.; the United States, 7·3 per cent.; Java, 8·9 per cent.; and other foreign countries, 5·9 per cent.

The extent to which India has thus come to be dependent upon other countries for the raw materials and manufactured articles necessary in the daily life of a modern civilised community is deplorable. The following classified table of the imports which came into India in the year ending March 1914, will give an idea of the extent of this dependence :—

	£
I.—*Food, drink, and tobacco* :—	16,441,330
Fish (excluding canned fish)	208,330
Fruits and vegetables	753,583
Grain, pulse and flour	185,560
Liquors	1,251,642
Provisions and oilman's stores	1,649,087
Spices	1,154,875
Sugar	9,971,251
Tea	152,409
Other food and drink, *i.e.*, coffee (other than roasted or ground) hops, etc.	511,623
Tobacco	501,923
II.—*Raw materials and produce, and articles mainly unmanufactured*	7,038,380
Coal, coke, and patent fuel	710,920
Gums, resins, and ice	175,764
Hides and skins, raw	101,066
Metallic ores and scrap iron or steel for manufacture	41,977
Oils	2,934,611
Seeds, including oil seeds	53,431
Tallow, stearine, wax	150,638
Textile materials	1,204,510
Wood and timber	515,590
Miscellaneous (including shells, chank, cowries, fish manure, pulp of wood and rags for paper)	1,149,873
III.—*Articles wholly or mainly manufactured*	96,769,443
Apparel	1,669,389
Arms, ammunition and military stores	236,713
Carriages and cars, including cycles and motor cars	1,422,667
Chemicals, drugs and medicines	1,605,699
Cutlery, hardware, implements (except machine-tools) and instruments	4,291,140

	£
Dyes and colours	1,510,933
Furniture, cabinet-ware, and manufactures of wood	224,323
Glassware and earthenware	1,728,667
Hides and skins, tanned or dressed, and leather	266,683
Machinery of all kinds (including belting for machinery)	5,508,397
Metals, iron and steel and manufactures thereof	10,633,249
Metals, other than iron and steel and manufactures thereof	41,010,801
Paper, paste board, and stationery	1,524,982
Railway plant and rolling stock	6,689,794
Yarn and textile fabrics	50,360,043
Miscellaneous (including prints, engravings, pictures, rubber manufactures, smokers' requisites, soaps, spirits perfumed, sticks and whips, stones and marble, toilet requisites, toys, and requisites for games and sports, umbrellas and umbrella fittings)	5,055,963
IV.—*Miscellaneous and unclassified, including living animals, fodder, bran pollards and articles imported by post.*	1,916,135
V.—*Government stores*	5,373,350
Total value of all imports, excluding treasure	£127,538,638

Chapter IV of our Report gives a more analysed and critical summary of the industrial deficiencies of India. It similarly points out that the list of industries which, though the materials and articles we import are essential alike in peace and war, are lacking in this country, is lengthy and ominous; and that until they are brought into existence on an adequate scale, Indian capitalists will, in times of peace, be deprived of a number of profitable enterprises, whilst, as experience has shown, in the event of a war which renders sea transport impossible, India's all-important existing industries will be exposed to the risk of stoppage, her consumers to great hardship, and her armed forces to the gravest possible danger. With the abundance of our raw materials, agricultural and mineral, with the great natural facilities for power and transport, with a vast home market to absorb all that we may manufacture, it should not be difficult to effectively cut down this list, if the Government will equip the people for the task by providing the necessary educational and banking facilities and extending to them the patronage and support of the State. How the Government may best do this is the question we have to answer.

Government Industrial Policy in Recent Years.

I have little to add to the history of Government industrial policy in recent years which is given in Chapter VIII of the Report. The account given there of the efforts made by Government for the improvement of Indian industries shows how little has been achieved. But I do not agree with my colleagues when they say (paragraph 111) that this has been "owing to the lack of a definite and accepted policy, and to the absence of an appropriate organisation of specialised experts." I share with them the regret that Lord Morley did not approve that part of the proposal of the Madras Government made in 1910, which urged that Government agency should be employed to demonstrate that certain industrial improvements could be adopted with commercial advantage; and I am thankful that in modification of that order, Lord Crewe, by his telegram, dated the 1st February, 1916, authorised the Government of India, pending final orders on this Commission's Report, "to instruct Local Governments that in cases in which they desire to help particular industries they may do so, subject to your approval and to financial exigencies, without being unduly restricted by my predecessor's rulings." But I cannot endorse that part of the Report which speaks of "the deadening effect produced by Lord Morley's dictum of 1910 on the initial attempts made by Government for the improvement of industries." (Introductory, page 4.) I think my colleagues have taken an exaggerated view of the effect of Lord Morley's refusal to sanction the particular part of the Madras Government's proposal to which reference has been made above. In justice to Lord Morley, and in order that the orders which he passed on the subject of technical education may be properly appreciated, I will quote below the following two paragraphs from the despatch in question, dated the 29th July 1910. Said His Lordship :—

> "I have examined the account which the Madras Government have given of the attempts to create new industries in the province. The results represent considerable labour and ingenuity, but they are not of a character to remove my doubts as to the utility of State effort in this direction, unless it is strictly limited to industrial instruction and avoids the semblance of a commercial venture. So limited, interference with private enterprise is avoided, while there still remains an ample and well-defined sphere of activity. The limit disregarded, there is the danger that the new State industry will either remain a petty and ineffective plaything, or will become a costly and hazardous speculation. I sympathise with the Conference and the Madras Government in their anxiety for the industrial development of the province, but I think that it is more likely to be retarded than promoted by the diversion to State-managed commercial enterprises of funds which are urgently required for the extension of industrial and technical instruction.
>
> "The policy which I am prepared to sanction is that State funds may be expended upon familiarising the people with such improvements in the methods of production as modern science and the practice of European countries can suggest; further than this the State should not go, and it must be left to private enterprise to demonstrate that these improvements can be adopted with commercial advantage. Within the limits here indicated it appears to me that the objects which the Industrial Conference had in view can all be accomplished by means of technical and industrial schools; it is in such schools that a knowledge of new industries and new processes can be imparted, that the use of new implements can best be taught and the technical skill of the artisans most readily improved. In a leather school the method of chrome tanning can be demonstrated and taught; in a weaving school the indigenous hand loom can be improved and the advantage of the improvement demonstrated. If the schools are properly managed, they will supply the private capitalist with instructed workmen and with all the information he requires for a commercial venture. To convert the leather or weaving school into a Government factory in order to demonstrate that articles can be manufactured and sold to the public at a profit, goes, in my view, beyond what is desirable and beyond what is found necessary in other provinces. My objections do not extend to the establishment of a bureau of industrial information, or to the dissemination from such a centre of intelligence and advice regarding new industries, processes or appliances, provided that nothing is done calculated to interfere with private enterprise."

As Lord Crewe pointed out in his despatch No. 24-Revenue, dated March 12th, 1912 :—

> " . . . the Government of Madras seemed to have placed too limited a construction upon the orders given in my predecessor's despatch of 29th July 1910. The policy which he then sanctioned was that State funds might be expended upon familiarising the people with such methods of production as modern science and the practice of European countries could suggest. This need not be interpreted as confining instruction solely to industrial schools. I am prepared to recognise that in certain cases instruction in industrial schools may be insufficient and may require to be supplemented by practical training in workshops, where the application of new processes may be demonstrated; and there is no objection to the purchase and maintenance of experimental plant for the purpose of demonstrating the advantage of improved machinery or new processes and for ascertaining the data of production."

Indian public opinion no doubt desired that the Government should go farther than Lord Morley had sanctioned. But even so, they would have been grateful if action had been taken within the "ample and well-defined sphere of activity" which he had sanctioned; if the funds which it was proposed to divert to State-managed commercial enterprises, had been devoted to "the extension of industrial and technical instruction," for which, his Lordship said, they were "urgently required"; if State funds had been "expended upon familiarising the people with such improvements in the methods of production as modern science and the practice of European countries could suggest." Their complaint was that that was not done. It is said in paragraph 199 of the Report that the Government (of India) "had neither the organisation nor the equipment to give effect even to the comparatively limited policy sanctioned by Lord Morley." The obvious answer is that the necessary organisation and equipment should have been created.

A Welcome Change.

The outbreak of the war drew forcible attention to the extent of India's dependence upon countries outside the British Empire, particularly upon Germany and Austria, for the supply of many of the necessaries of life for her people, and some time after the commencement of the war, the Government of India resolved to examine the question of the industrial policy which the Government should pursue in the altered state of things in India. In their despatch to the Secretary of State, dated the 26th November 1915, Lord Hardinge's Government put the case for a change of policy in very clear and forceful language. They said:—

"It is becoming increasingly clear that a definite and self-conscious policy of improving the industrial capabilities of India will have to be pursued after the war, unless she is to become more and more a dumping ground for the manufactures of foreign nations who will be competing the more keenly for markets, the more it becomes apparent that the political future of the larger nations depends on their economic position. The attitude of the Indian public towards this important question is unanimous, and cannot be left out of account. Manufacturers, politicians and the literate public have for long been pressing their demands for a definite and accepted policy of State aid to Indian industries; and the demand is one which evokes the sympathy of all classes of Indians whose position or intelligence leads them to take any degree of interest in such matters." The despatch emphasised "the need for an industrial policy which will enable technical education in India to produce its best results, and which will lighten the pressure on purely literary courses and reduce the excessive demand for employment in the services and callings to which these courses lead up."

Finally the Government said:—

"After the war India will consider herself entitled to demand the utmost help which her Government can afford to enable her to take her place, so far as circumstances permit, as a manufacturing country."

The acceptance of this policy by the Secretary of State for India and the appointment of this Commission to consider and report in what ways this help may be given was welcomed by Indians with feelings of gratitude and hope, like the dawn of day after a dark and dreary night. But the hope is occasionally clouded by a recollection of the fact that the Labour Party joining with the Irish Nationalist and the Lancashire vote mobilised its forces against the Government in England against the raising of the import duty on cotton goods in India—even while the Indian cotton excise duty, which India has regarded as a great and crying grievance all these twenty-one years, was still allowed to continue—and that so highly honoured a statesman as Mr. Asquith gave his support to the Government policy only on the understanding that this in common with all other fiscal issues would be reconsidered at the end of the war. Indians remember, however, with gratitude the firm attitude which Mr. Austen Chamberlain, the then Secretary of State for India, adopted in the matter, and the reply which he gave to the Lancashire deputation that waited on him with reference to that simple fiscal measure, without which, as he told the deputation, it would have been impossible for India to make the contribution of £100 millions to the cost of the war.

The brief narrative which I have given here of the industrial relations of India with England, and of the policy which England has pursued towards

India, will, I hope, lead some of those of my English fellow-subjects, who are unwilling to let the Government of India protect and promote Indian industries under a wrong apprehension that that would injure English interests, to recall to mind how much India has contributed to the prosperity of England during a century and a half, and how much she has suffered by reason of the illiberal policy which has hitherto been pursued towards her. It will lead them, I hope, to reflect that the result of this policy is that, after a hundred and fifty years of British Rule, India, with all her vast natural resources and requirements, is the poorest country in the world, and that comparing her pitiable condition with the prosperous state of the self-governing Dominions which have enjoyed freedom to develope their industries, they will recognise the necessity and the justice of allowing India liberty to regain national health and prosperity. Such a policy will not benefit India alone. It will benefit England also. For if India will grow rich, if the standard of living in India will rise, her vast population will naturally absorb a great deal more of imports than it does at present. This view was repeatedly urged by Mr. Dadabhai Naoroji, and it is fully supported by the history of other countries which have become prosperous during recent times. The United States offer an illustration. The following figures show how their imports have grown with their prosperity :—

Year.	Imports in millions of dollars.
1860	353
1870	435
1880	667
1890	789
1900	849

The same truth is illustrated by the history of the commerce of Japan. As Japan has been developing her own manufactures and growing in affluence, she has been furnishing a rapidly growing market to the merchants of the world. The following table makes this clear :—

ANNUAL AVERAGE IMPORTS OF JAPAN IN RECENT DECADES.

Values in Millions of Yen.

—	From the United Kingdom.	From Germany.	From U. S. A.	From other countries.	From all countries.
1881-1890	19·6	3·4	4·2	19·3	46·5
1891-1900	46·6	14·8	22·8	87·0	171·2
1900-1909	84·3	36·1	65·8	199·8	386·0

Commenting on the growth and variety of imported manufactures in the United States noted above, Mr. Clive Day says in "History of Commerce" (page 568) :—

> "It is probable that the United States will always continue to import manufactured wares like those named above, in great variety and amounting in the total to considerable value. We cannot afford to refuse the contributions of peoples who have specialized in various lines, and by reason of inherited taste and skill, or with the aid of exceptional natural resources, can offer us what we cannot readily produce ourselves."

This is exactly what I would say with regard to our future, assuming that we are allowed to develope our home industries to the fullest extent we can. But I need not labour this point further. I am glad to find that 'the Committee on Commercial and Industrial Policy after the War,' of which Lord Balfour of Burleigh was the Chairman, has expressed the same view. In paragraphs 232 and 233 of their Final Report they say:—

> "Whilst Europe as a whole may be said to be divided into settled fields of international competition where local circumstances, convenience of transport, and suitability of production for local needs, have become the controlling factors, there remain vast markets still practically untouched for the future development of the exporting nations of the world. China, with its 400 millions of population, an old and industrious civilisation, must in the near future develope its already great and growing demands for products of our trades. There are great potentialities in India and there is also the demand of Siberia and the smaller Far Eastern countries, which are likely in future to afford profitable markets.
>
> "It is true that in this sphere the competition of Japan will have to be increasingly reckoned with, but we have no doubt that with a rise in the standard of living of Eastern peoples there will come a corresponding increase of the quantity and improvement of the quality of the goods demanded. This development cannot fail to be of advantage to British industry, and for this reason, if for no other, we desire to emphasise the importance of all measures, including particularly the rapid extension of Railways, likely to promote the economic well-being of India."

The hope of Indians for the industrial development of their country has been further strengthened by the knowledge that, like their noble predecessors in office, the present Viceroy and the Secretary of State are also convinced of the necessity of a liberal policy being adopted in respect of Indian industrial development. They have read the following passage in the Report on Constitutional Reforms with great satisfaction:—

> "On all grounds, a forward policy in industrial development is urgently called for, not merely to give India economic stability; but in order to satisfy the aspirations of her people who desire to see her stand before the world as a well-poised, up-to-date country; in order to provide an out-let for the energies of her young men who are otherwise drawn exclusively to Government service or a few overstocked professions; in order that money now lying unproductive may be applied to the benefit of the whole community; and in order that the too speculative and literary tendencies of Indian thought may be bent to more practical ends, and the people may be better qualified to shoulder the new responsibilities which the new constitution will lay upon them. These considerations led Lord Hardinge's Government to recommend the appointment of the Industrial Commission which is at present sitting.
>
> "These are political considerations peculiar to India itself. But both on economic and military grounds imperial interests also demand that the natural resources of India should henceforth be better utilised. We cannot measure the access of strength which an industrialised India will bring to the power of the Empire; but we are sure that it will be welcome after the war."

How far the hope so raised will be realised, will depend largely upon the decision of the vital question whether the power as well as the responsibility of promoting the industrial development of India, shall be placed in the Government of India, acting under the control of the elected representatives of the people in the Legislative Council. This factor governs all our recommendations.

Industries and Agriculture.

In Chapter V of the Report dealing with industries and agriculture, my colleagues say:—

> "We take this opportunity of stating in the most emphatic manner our opinion of the paramount importance of agriculture to this country, and of the necessity of doing everything possible to improve its methods and increase its output."

They go on to say :—

> "Such improvement will, we anticipate, be mainly effected by the organisations which are in process of development under the charge of the imperial and provincial Departments of Agriculture, and though the results attained are not yet of much economic importance, they are steadily growing and will eventually demand large manufacturing establishments to produce the machinery, plants and tools which the raiyats will find advantageous as labour-saving devices."

They point out the possibilities of improved agricultural methods and suggest that there is much scope for the use of power-driven machinery in agriculture for lifting water from wells, channels, tanks and rivers, for irrigation and for other purposes, and for improving the land by draining low-lying ground and by deep ploughing, etc. They also recommend the provision of hand machinery of improved types, especially for the reaping, threshing and winnowing of crops. They go on to say :—

> "India is not at all yet accustomed to the free use of mechanical appliances, and it should be an important function of the Departments of Industries and Agriculture to encourage their introduction in every possible way. For a long time to come the employment of machinery in agriculture in India will largely depend upon the completeness and efficiency of the official organisation which is created to encourage its use and to assist those who use it."

In this connection I would draw attention to the opinion of Mr. James MacKenna, the Agricultural Adviser to the Government of India. At page 29 of his valuable pamphlet on "Agriculture in India," published in 1915, he says :—

> "We have seen that the introduction of European machinery has always figured prominently in the efforts of the amateur agricultural reformer. Much success has, undoubtedly, been obtained in the introduction of grain-winnowers, cane-crushing machinery, etc. But in recommending the introduction of reaping machines or heavy English ploughs, caution is necessary. Reaping machines may be useful on large estates where labour is scarce, but the whole rural economy of a tract where population is dense may be upset by their use. A large amount of cheap labour which ordinarily does the reaping is thrown out of employment; the gleaners lose their recognised perquisites. In the case of heavy ploughs, the advisability of deep ploughing has first to be proved. In both cases the capacity of the available cattle and the difficulty of replacing broken spare parts and of carrying out repairs are serious obstacles to the introduction of foreign machinery. As in the case of plants, the improvement of the local material which the cultivator can himself make and repair and which his cattle can draw, seems the more hopeful line of improvement."

I entirely endorse this opinion. The difficulties pointed out by Mr. MacKenna apply with equal, if not greater, force, in the case of power-driven machinery for the purposes indicated above. As my colleagues have observed "in India agricultural conditions are widely different from those in Europe and Germany," and "as yet very little of mechanically operated plant has come into use" here, "chiefly because holdings are small and scattered, and ryots possess little or no capital." "The results achieved in this direction in the south of India" are also "not very important perhaps, if measured by their immediate economic effect." While, therefore, I appeciate the value of the use of power-driven machinery in the development of agriculture, when economic conditions should favour its introduction, I do not agree with the recommendation "that it should be an important function of the Departments of Industries and Agriculture to encourage their introduction in *every possible way.*" I apprehend that with such a recommendation from the Commission, the zeal for promoting mechanical engineering interests and establishments may push the use of power-driven machinery without due appreciation of the economic interests of agriculturists in the present circumstances of the country. For these reasons, and because in any case the introduction of power-driven machinery will take a long time, I think it my duty to draw attention to other means of improvement, particularly to agricultural education.

The history of agriculture in India during British rule has recently been told by Mr. MacKenna in his pamphlet referred to above. Agriculture is by far the greatest of the industries of India, and nearly 200 millions of its immense population are dependent for their livelihood on agriculture or on industries subsidiary to it. The Famine Commission of 1880 made very strong recommendations as to the necessity of establishing departments under a Director in each province to promote agricultural enquiry, agricultural improvement and famine relief. The departments were constituted, but by a Resolution published in 1881 the Government of India decided to postpone agricultural improvement until the scheme of agricultural enquiry had been completed. Nothing was done till 1889, at the end of which year the Secretary of State sent out Dr. Voelcker of the Royal Agricultural Society to enquire into and advise upon the improvement of Indian agriculture. After touring over India and holding many conferences, Dr. Voelcker recommended a systematic prosecution of agricultural enquiry and the spread of general and agricultural education, and laid down in considerable detail the lines on which agricultural improvement was possible. An Agricultural Chemist and an Assistant Chemist were appointed in 1892 to carry on research and to dispose of chemical questions connected with forest and agriculture. In 1901 an Inspector-General of Agriculture was appointed. Two other scientists were added to the staff in 1903. Mr. MacKenna says :—

> "The object aimed at was to increase the revenues of India by the improvement of agriculture; but nothing was done for that improvement, and the expansion of the Land Records staff and the compilation of statistics almost entirely occupied the attention of the Provincial Departments."

An Agricultural Research Institute was established at Pusa in 1905 with the help of a generous donation of £30,000 made to the Viceroy by Mr. Henry Phipps of Chicago. In 1905-06 the Government of India announced that a sum of 20 lakhs (subsequently raised to 24 lakhs) would annually be available for the improvement of agriculture. Agricultural colleges were accordingly re-organised or started at Poona, Cawnpore, Sabour, Nagpur, Lyallpur and Coimbatore. These colleges have been doing good work, but very little progress has been made with the agricultural education of the people. I wish to acknowledge here the improvement which has been brought about in agriculture by means of our large irrigation works, which the Government have constructed, the improvement of wheat and cotton and in other ways. That improvement has been great and the Government is entitled to full credit for it. But I wish to draw attention to the urgent need and great possibilities of further improvement. Irrigation requires to be much more extended. A more systematic and extended programme of improvement requires to be adopted, the most important item in which should be agricultural education.

Agricultural Education.

Writing in 1915 on this subject Mr. MacKenna said :—

> "There is probably no subject connected with agriculture on which so much has been written as agricultural education; none, perhaps in which less has been effected. It is a constant anxiety to agricultural workers who mainly strive after an ideal which seems untenable. It has been debated at numerous conferences and has been the text of many writers, but there are practically no results to show." "The Famine Commissioners, so long ago as 1880, expressed the view *that no general advance in agricultural system can be expected until the rural population had been so educated as to enable them to take a practical interest in agricultural progress and reform.* These views were confirmed by the Agricultural Conference of 1888. . . . . The most important, and, probably, the soundest proposition laid down by the conference was that it *was most desirable to extend primary education amongst agricultural classes.* But with the enunciation of this basic principle other resolutions were passed, which,

while containing much that was excellent, probably led to the extraordinary confusion of subsequent years." For some time "the dominating idea was that it was necessary *to teach agriculture,* somehow or other, in rural schools. Fortunately this idea has now been abandoned. It is now agreed that agriculture, as such, cannot be taught in schools; that rural education must be general and agricultural education technical." . . . . "The view now taken is that, instead of endeavouring to teach agriculture as such, an attempt should be made to impart to the general scheme of education a markedly agricultural colour and to encourage powers of observation and the study of nature with special reference to the surroundings of each school. With this object text-books are being re-written so as to include lessons on familiar objects; nature study is being taught and school gardens have been started. There are, however, serious difficulties in obtaining suitable teachers. But, as I have already said, more will depend on the natural awakening of the intelligence of pupils by the spread of general education than on specialised training. And in primary schools the essential thing is to establish general education on a firm basis so that the pupils may develope powers of observation and of reasoning. If these be done, interest in their surroundings will naturally follow."

Mr. MacKenna says in the end:—

> "Any attempt to teach agriculture in India, before investigation has provided the material, is a fundamental mistake which has seriously retarded development, and this mistake has affected, not only elementary, but to a much greater extent collegiate, education."

This is where we stood after thirty-five years of enquiry, discussion and trial!

Other civilised countries took a much shorter period to decide upon a definite course of agricultural education and have prospered on their decision. In Sir Horace Plunkett's Report of the Recess Committee of 1896 an account is given of the systems of State aid to agriculture and industry which were prevalent before that year in various countries of Europe. Though these countries, as also America and Japan, have made much greater progress since then both in agricultural education and improvement, that report is still of great value to us and will amply repay perusal. I will extract only one passage from it here. Said Sir Horace Plunkett and his colleagues:—

> "The most positive action of the State in assisting agriculture is taken in connection with education. Everywhere it is accepted as an axiom that technical knowledge and general enlightenment of the agricultural class are the most valuable of all levers of progress. The great sums spent by the various countries in promoting technical education as applied to agriculture, as well as to other industries, prove this. M. Marey-Oyens, the head of the Dutch Board of Commerce and Industry, and President of the Agricultural Council says:—'Every guilder spent in the promotion of agricultural teaching brings back profit a hundred-fold.' 'Every franc spent in agricultural teaching brings a brilliant return,' says the Belgian Minister of Agriculture in his message to Parliament last year. M. Tisserand attributes the great progress made by French agriculture since 1870, in a large measure 'to our schools, our professors, our experiment stations, and the illustrious men of science, whom the administration has induced to devote themselves to the study of agricultural questions.' Mr. M. H. Jenkins, in his Report to the Royal Commission on Technical Instruction, says 'the results of agricultural education in Denmark have been something extraordinary. Danish butter is now the best in the world; in 1880 it was described by the British Vice-Consul at Copenhagen as "execrably bad"; the progress since is directly traceable to agricultural education.'"—(*Report,* pages 54-55.)

It is hardly necessary to refer at any length to the great progress of agricultural education and improvement in America or to the enormous wealth and prosperity which has resulted therefrom. But I might refer here to the case of Japan. We know that Japan has made remarkable progress in agriculture. She developed an excellent system of agricultural education many years ago. In the valuable "Note on Agriculture in Japan," which Sir Frederick Nicholson submitted to the Commission along with his written evidence, he describes the system of agricultural education which he found at work in Japan in 1907. It is not necessary for me to describe the system here. My object simply is to draw attention to the necessity, in the interest of the improvement of agriculture and agriculturists, of early steps being taken to devise a system of both general and agricultural education for the masses of our agricultural population.

I would also recommend that the attention of the Agricultural Department be invited to the desirability of carrying out those other recommendations of Dr. Voelcker which have not yet been carried out, particularly those relating to the "establishment wherever possible of Fuel and Fodder Reserves." Our attention was particularly drawn to the fact that the high prices of fuel and fodder are inflicting serious hardship and loss upon the people in general and of agriculturists in particular. I may note that we were informed that last year about 40,000 acres of irrigated plantation were established by the Forest Department in the Punjab, in order to meet provincial requirements.

The high prices of foodstuffs and the consequent suffering to which the bulk of the people are exposed have made the question of increasing the yield of our food crops also one of great and pressing importance. In his pamphlet on the "Agricultural Problems of India," which Rai Gangaram Bahadur submitted to the Commission, he argues that "we are producing in a normal year, just enough to meet our requirements (of food consumption) with no surplus to meet the contingency of a failure of the rains in the ensuing year." We are also confronted with the fact that in India the yield per acre of crops is very much lower than what it is in other countries. The figures given by Rai Gangaram Bahadur at page 12 and in Table VIII of his book are instructive. The average yield per acre of wheat in Bombay and the United Provinces was 1,250 lbs.; in the United Kingdom, it was 1,973 lbs.; in Belgium, 2,174 lbs.; in Denmark, 2,526 lbs.; in Switzerland, 1,858 lbs. The average yield per acre of barley in the United Provinces was 1,300 lbs.; in the United Kingdom, 2,105 lbs.; in Belgium, 2,953 lbs.; in Denmark, 2,456 lbs.; in Switzerland 1,940 lbs. The average yield per acre of maize in the North-West Frontier was 1,356 lbs.; in Canada, 3,487 lbs.; in New Zealand, 3,191 lbs.; in Switzerland, 2,198 lbs. The average yield per acre of rice in India is only half of what it is in Japan. The possibilities of development that lie before us are therefore vast, and the call for measures for improvement is urgent and insistent. It is the call both of India and of the Empire, and I strongly recommend that the matter should receive prompt and adequate attention from the Agricultural Departments—both Imperial and Provincial.

In this connection I desire also to draw attention to the necessity of providing greater financial facilities for agricultural improvement. So long ago as 1882, that revered friend of India, Sir William Wedderburn, advocated the establishment of agricultural banks for this purpose. The Indian National Congress pressed the suggestion upon the attention of Government. But it has not yet been carried out. I would draw attention to the very valuable paper on "The Re-organization of Rural Credit in India," which was read by Mr. Ranade before the first Industrial Conference at Poona in 1891. (Ranade's *Essays*, pages 41-64.) It is a powerful plea for the establishment of agricultural banks. I might add that, besides other countries mentioned by Mr. Ranade, Japan has provided such facilities as are here recommended for the improvement of its agriculture. The Japan Year Book for 1917 says:—

> "There are two kinds of agricultural credit. They are long credit and short credit, the former for the purchase of farm land and for the development of farm land and other permanent improvements for which a loan for a term of 50 years or less is allowed. The short-term credit is one that is to be used mostly for the purchase of fertilizers, farm implements, or food for cattle. Our banks usually give credit for a term of five years or less. There are also credit associations for supplementing these agricultural banks."

Technical Education.

The modern system of technical education may be said to date from the famous Universal Exhibition held in London in the year 1851. Speaking generally, Englishmen did not believe in the value of technical education, and much effort has been necessary in England itself to make them do so. One of the earliest of these efforts was made by Mr. J. Scott Russell, who published a valuable book in 1869, named "Systematic Technical Education for the English People." In this book, after showing that education should be both general and special, he said :—

"The highest value in the world's markets will be obtained by that nation which has been at most pains to cultivate the intelligence of its people generally, and afterwards to give each the highest education and training in this special calling. In other words, the value of the nation's work will vary with the excellence of the national system of technical education. All I have said above seems axiomatic. To me it is so, but I trust the reader will not be offended if I am obliged to treat it quite otherwise. The English people do not believe in the value of technical education. Still less do they believe in the value of a national system of education, and still less in the duty of the Government, the legislature, and the educated part of a community, to undertake the education of a whole people. I am therefore compelled to prove as mere matters of facts that which the accomplished scholar, or observant traveller, takes as an axiom on which argument is wasted. It is the object of this chapter to prove that technical education has brought good of a national and commercial kind to those who possess it; that the want of it is attended with pecuniary loss, and that there is social danger to the community in our continued neglect of it.

"Of late years a series of great public events have been taking place, which have been of great national value in serving to awaken the British people—For half a century they had been enjoying the fruits of the inventions of a few men of genius who had created the whole system of modern manufacturing, and Providence had also endowed them with the accumulated wealth of countless centuries stored up in the bowels of the earth in the shape of coal and iron, ready to be used or wasted and worked out in this manufacturing century. The genius of a few men having set coal and iron to do the manufacturing work of mind and man, the citizens of England had begun to think that it was they who were superior in intelligence and civilization to the un-coaled, un-ironed, un-engineered nations around them. For half a century nothing occurred to awaken them from this dream, and for that half century the works of English engineers and English iron and coal bore the highest reputation, and earned the highest prices in the world.

"Eighteen years ago there began a series of competitive trials of intelligence and skill between the citizens of the different civilized nations of the world. The scene of the first trial was in London in 1851. It was the famous Universal Exhibition of the Industries and Products of all nations. *In that great school the civilized nations of Europe had their first lesson in technical education.* They were able to see in how many things England retained her hereditary excellence and England was able to see in how many branches of taste and skill other nations possessed qualities in which she was wanting."—(*Systematic Technical Education for the English People*, by J. Scott Russell, London, Bradbury, Evans and Co., 11, Bouverie St., 1869, pages 79-81.)

Mr. Russell went on to say that up to 1851, and for many years after, England held supremacy in the great objects of manufacturing and constructive skill. But she lagged behind other nations in some other arts. For instance—

"The Exhibition of 1851 had disgusted the whole nation with its blue earthenware plates, cups and saucers, borrowed from the 2,000 years' tradition of China, and with its huge lumps of glass, called decanters and glasses, cut or moulded into hideous distortions of form . . . All England was struck by the amazing superiority of some continental nations in the beauty and grace of design, which sufficed to convert the rude and nearly worthless material of clay and flint into valuable and invaluable works of art, in earthenware and glass. She occupied the four years' interval between the Exhibitions of 1851 and 1855 in collecting and diffusing through the manufacturing countries, the best models of the best masters, in establishing for the potteries and glass works schools of design, and in training teachers for art workmen. These young institutions already bore fruit in 1855, and (when the second Exhibition took place in Paris in 1855) England was no longer outstripped in pottery and glass."

On the other hand, the Exhibition of 1851 made the French and German nations fully realise their inferiority to England in the manufactures of iron and steel, the great instruments of skill, industry, mechanical power, and transport. When the Exhibition of 1855 took place, it was found that they had already recorded much advance in the manufacture of iron, steel and other metal. "*They had already established schools in every metropolis, large town or centre of industry, for educating professional men and masters, for training foremen and skilled workmen, and for educating apprentices.*"

The fourth Exhibition took place in Paris in 1867. It gave the nations, and especially England, a final lesson.

> "By that Exhibition" says Mr. Scott Russell, "we were rudely awakened and thoroughly alarmed. We then learnt, not that we were equalled, but that we were beaten—not on some points, but by some nation or other on nearly all those points on which we had prided ourselves. . . . . England was convinced that she had been asleep, and that a whole generation of wakeful, skilled workmen had been trained in other countries during the interval between 1851 and 1867."—(*Ibid*, page 86.)

The jurors who had been appointed at the Paris Exhibition and the Government reporters made their report. On this report the Government sent abroad a Commissioner to ascertain whether the alleged defects of the English system of education, and the inferiority of the English to some other people in some sort of technical skill, were real or imaginary. Mr. Samuleson, M.P., travelled in France, Belgium and Germany, examining as he went the most famous establishments on the continent which stood in direct rivalry to England. "He found," said Mr. Russell, "everywhere in these establishments men of all ranks better educated than our own; working men less illiterate—foremen and managers well-educated, and masters accomplished, well-informed, technical men." He summed up the result of his examination as follows:—

> "I do not think it possible to estimate precisely what has been the influence of continental education on continental manufactures . . . That the rapid progress of many trades abroad has been greatly facilitated by the superior technical knowledge of the directors of works everywhere, and by the comparatively advanced elementary instruction of the workers in some departments of industry, can admit of but little doubt . . . Meanwhile we know that our manufacturing artisans are imperfectly taught, our agricultural labourers illiterate; neither one nor the other can put forth with effect the splendid qualities with which Providence has endowed our people. Our foremen, chosen from the lower industrial ranks, have no sufficient opportunities of correcting the deficiencies of their early education; our managers are too apt, in every case of novelty, to proceed by trial and error, without scientific principles to guide them; and the sons of our great manufacturers too often either despise the pursuits of their fathers, as mere handicrafts unworthy of men of wealth and education, or else, overlooking the beautiful examples which they afford of the application of natural laws to the wants of men, follow them solely as a means of heaping up more wealth, or at the best for want of other occupation: to the evils of such a condition not only our statesmen, but also our people, are rapidly awakening, and the disease being once acknowledged, I believe the remedy will soon be applied."

The following statement of one of the jurors consulted by the Commissioner expressed the general sense of those who had been examined. Said Mr. Mundella:—

> "I am of opinion that the English workman is gradually losing the race, through the superior intelligence which foreign Governments are carefully developing in their artisans. . . . . The education of Germany is the result of a national organisation, which compels every peasant to send his children to school, and afterwards affords the opportunity of acquiring such technical knowledge as may be useful in the department of industry to which they were destined. . . . . If we are to maintain our position in industrial competition, we must oppose to this national organisation one equally effective and complete; if we continue the fight with our present voluntary system, we shall be defeated, generations hence we shall be struggling with ignorance, squalor, pauperism and crime; *but with a system of national education made*

compulsory, and supplemented with art and industrial education, I believe within twenty years England would possess the most intelligent and inventive artisans in the world."—(Pages 97 and 98.)

(The italics throughout are mine.)

The people and Parliament of England recognised the soundness of this opinion. The Elementary Education Act was passed in 1870, an expenditure of many millions a year was agreed upon, and elementary education made compulsory. The provision for supplementing this education with industrial and technical education was slower to come, but come it did. England has made a great deal of provision since then for imparting technical and scientific education in her schools, colleges and universities. The number of these latter has been raised from 1860 from nine to eighteen. It is this which has enabled England to maintain her high position and to keep up her industrial eminence. It is this which has enabled her to fight the splendid fight she has fought in this war. For, though every lover of liberty must rejoice at the invaluable help which the United States of America are now giving to the cause of freedom, it is but bare justice to say that, unprepared though England was before the war, it is British brains and British technical skill, united no doubt with French brains and French technical skill, and supported by British and French hearts of steel, that have enabled Britain and France to baffle Germany, and made it possible for the Allies to achieve a final victory. And yet as the reports of the various departmental committees of 'the Committee on Commercial and Industrial Policy after the War' show, the wisdom and experience of England is loudly calling for "widespread and far-reaching changes in respect of primary and secondary education and apprenticeship," and for "better technical and art education" for her people in order that her industrial position after the war may be quite secure.

I have referred at length to the history of the progress of education, both general and technical, in England, as it has a great lesson and an inspiration for us. Our education to-day is in many respects nearly in as bad a condition as was England's in 1869; and, in my opinion, the course which was then suggested by Mr. Mundella and Mr. Samuelson in the passages I have quoted above, is the exact course which should be adopted here. It was the misfortune of India that when our English fellow-subjects, who have taken upon themselves the responsibility for the welfare of the people of India, were convinced of the need of universal elementary education in England, they did not introduce it at the same time in India also. If this had been done, India would not have stood so far behind other nations as she does to-day. However, the neglect of the past should be made up, as much as possible, by the adoption of prompt and effective measures now. The need for such measures has become greater by the great changes which have taken place during the interval. The commercial war which has long been going on will become much keener after the war. India will be much more exposed to the competition of nations which have built up their industries upon a widespread and comprehensive system of technical education. In this category come not only the nations of Europe and America, but also Japan. As the Government of India deputed a special officer to Japan to obtain information for us, so that "we may know exactly what her Government has done to aid her people in the notable advance which they have made," I invite particular attention to the progress of education in that country.

It is clearly established that the development of Japanese industries has been built upon "a system of technical education which included everything required to enable her to occupy her proper place among the manufacturing nations of the world." If the industries of India are to develop, and Indians to have a fair chance in the competition to which they are exposed, it is essential that a system of education at least as good as that of Japan should be introduced in India. I am at one with my colleagues in urging the fundamental necessity of providing primary education for the artisan and labouring population. No system of industrial and technical education can be reared except upon that basis. But the artisan and labouring population do not stand apart from the rest of the community; and therefore if this *sine qua non* of industrial efficiency and economic progress is to be established, it is necessary that primary education should be made universal. I agree also in urging that drawing and manual training should be introduced into primary schools as soon as possible. In my opinion until primary education is made universal, if not compulsory, and until drawing made a compulsory subject in all primary schools, the foundation of a satisfactory system of industrial and technical education will be wanting. Of course this will require time. But I think that that is exactly why an earnest endeavour should be made in this direction without any further avoidable delay.

Sir Frederick Nicholson says in his Note on Japan :—

> "The leap at education which the whole nation has made under the compulsory system is shown by the fact that while the primary school system was only formulated in 1872, by 1873 the number at these schools had already reached 28 per cent., by 1883, 51, by 1893, 59, and in 1904, 93 per cent. of children of a school-going age."

This furnishes us with an estimate of the time that will be needed and also an exhortation to move forward. It is upon this basis that industrial and technical education now rests in Japan. But the two kinds of instruction have grown together there, and so I think they should largely grow together here also. Towards this end, I should connect the measures of industrial and technical education which my colleagues have proposed, a little further with the system which already exists in the country. I would utilise the existing schools as far as possible not only for imparting a progressive course of drawing, but also for offering an optional course in elementary physics and chemistry, and carpentry and smithy. I would suggest that the Directors of Public Instruction of each province may be asked, in consultation with the Directors of Industries, to recommend changes in the curricula of the schools, primary, secondary and high, with a view to make them practical, so that they may form a part of the system of technical education.

I cannot close this portion of my note better than by adopting, with necessary modifications, the concluding remarks of Mr. Samuelson on the subject of technical education :—

> "In conclusion I have to state my deep conviction that the people of *India* expect and demand of their Government the design, organisation, and execution of systematic technical education, and there is urgent need for it to bestir itself, for other nations have already *sixty* years' start of us, and have produced *several* generations of educated workmen. Even if we begin to-morrow the technical education of all the youths of twelve years of age who have received sound elementary education, it will take seven years before these young men can commence the practical business of life, and then they will form but an insignificant minority in an uneducated mass. It will take fifteen years before those children who have not yet begun to receive an elementary education shall have passed from the age of 7 to 21 and represent a completely trained generation; and even then they will find less than half of their comrades educated. In the race of nations, therefore, we shall find it hard to overtake the *sixty* years we have lost. To-morrow, then, let us undertake with all energy our neglected task; the urgency is twofold,—a *small proportion* of our youth has received elementary, but no technical education : for that *portion* let us at once organise technical schools in every small town, technical colleges in every large town, and a technical university in the metropolis. The *rest* of the rising generation has received no education at all, and for them let us at once organise elementary education, even if compulsory."

The Training of Mechanical Engineers.

I fully agree with my colleagues as to the necessity of a full measure of practical workshop training for artisans, foremen and mechanical engineers. But I have doubts whether the system they propose would give sufficient general liberal education to even would-be mechanical engineers. I also apprehend that the schools attached to railway workshops will not admit of a sufficient number of Indians obtaining training in them. My colleagues also say that as the development of the country proceeds the number of students will increase. I join with them, therefore, in recommending that the existing engineering colleges should make provision for the higher technical instruction of mechanical and electrical engineers. I would only add that substantial grants should be given to these colleges for this development and the standard of education demanded of the mechanical engineers whom they are to educate, should not be inferior to that of a B.Sc. in Engineering of the University of London. This would be best secured by attaching these colleges to Universities, where this is not already the case.

There are at present only two teaching Universities in India. I hope that the Calcutta University will soon develop further teaching functions. In my opinion every teaching University should be encouraged to provide instruction and training in mechanical and electrical engineering under its own arrangements. The needed measure of workshop practice can be provided by arrangements with railway and other workshops existing in or near the cities or towns where they exist; and where this may not be feasible, they should be encouraged to establish sufficiently large workshops to be run on commercial lines as a part of their engineering departments. Under such an arrangement the students will be able to spend their mornings in the workshops and their afternoons at the classes at the University, they will live in an atmosphere of culture, and will cultivate higher aims and ideals than they are likely to, in schools attached to railway workshops. As our mechanical engineers are to play a great part in the future development of the country, it seems to me highly desirable that they should combine culture and character with expert knowledge and technical skill. And nothing is better calculated to ensure this than that they should be brought up under the elevating influences of a University and should bear its hall-mark.

I would also recommend that provision for the training of electrical engineers should be made simultaneously with that for mechanical engineers, and should not be postponed to an indefinite future date. I think it will not be long before electrical manufactures will be started in India. The need for these is fully pointed out in the chapter on the industrial deficiencies of India. The use of electrical machinery is steadily growing, and will grow at a more rapid rate in the future; and, if even for present requirements, we leave it to the managers of electrical undertakings to train their own men, we shall be driving an increasing number of Indian youths to go abroad to be trained as electrical engineers.

Higher Technological Training.

I agree with my colleagues that it is urgently necessary to prepare for a higher technological training which will provide the means whereby the science students of the colleges affiliated to the Universities may learn to apply their knowledge to industrial uses, and that the simplest way of meeting this demand will be to expand the engineering colleges by the creation of new departments for the higher technical instruction of mechanical and electrical engineers.

But I doubt whether it will be best to add departments of general technological chemistry to these engineering colleges where they are not parts of a teaching University. Where they are not, I think that they should be developed into full colleges of engineering, by provision being made for teaching other branches of engineering in them, such as railway engineering, and sanitary engineering, for which no satisfactory provision exists here at present.

As regards the teaching of general technological chemistry, I would recommend that this should be developed at the teaching Universities and at first-rate colleges affiliated to Universities. Every one of these has a more or less well-equipped laboratory, and by special grants, such as are given by the Board of Education to Universities and University Colleges in the United Kingdom, they should be helped to strengthen their staffs and to improve their laboratories for this purpose. We should thus give a practical value to the teaching of chemistry which is going on at present in our colleges. In view of the industrial expansion which we expect, the demand for students trained in general technological chemistry is likely to be very great. If provision is made for teaching it at the Universities or University Colleges, a much larger number of students is likely to be attracted to it than if it is made at engineering colleges. A sufficient number of scholarships and fellowships should be provided at every one of these institutions to attract and encourage bright students to devote themselves to the subject.

Imperial Engineering Colleges or an Imperial Polytechnic Institute.

My colleagues think that it will be necessary ultimately, if not in the immediate future, to provide India with educational institutions of a more advanced character. They think that, for some time to come, the demand for this higher training can best be met by the provision of scholarships to enable students to proceed abroad; but that as soon as our foregoing recommendations have had time to develop their full effect, it would be advisable to proceed further and establish at least two imperial colleges of very highest grade, one of which should cover every branch of engineering, while the other should be devoted mainly to metallurgy and mineral technology, the developments of which are certain to be on a very extensive scale. They say that this ideal should always be kept in sight as the goal.

I agree with my colleagues that in the immediate future the demand for the higher training here contemplated can only be met by the provision of scholarships to enable students to proceed abroad. I go further. I think that even when we have established our proposed higher colleges, we shall have to send our best scholars abroad to improve and perfect their knowledge. With all the provision for higher education which Japan has made in her own country, she has continued to send a large number of her students abroad. The Japanese Year Book for 1917 shows that there were 2,213 *ryugakusei*, or foreign-going students, staying abroad in 1915,—the bulk of them in the United States of America. The number of students of both sexes which Japan has sent to Europe and America since the opening of the country to foreign intercourse must reach enormous figures, says the same Year Book, especially when students who have gone abroad at their own expense are included. The demand for expert knowledge and technical skill will be so great in India, if we are to achieve in any measure the progress we desire, that it is desirable that the provision for scholarships should be greatly increased, and students should be largely selected as is done in Japan, from among those who have done teaching work for some years after completing their academic courses.

But after all that may be done in this direction, the large needs of the education of the youth of a country which is equal to the whole of Europe minus Russia, cannot be met in this manner. Those needs, and the vast possibilities of development which lie before us, demand that at least one first-class Imperial Technological or Polytechnic Institute should be established in India without any further delay. Indian public opinion has long and earnestly pleaded for the establishment of such an institute in the country, as witness the resolutions of the Indian National Congress and the Indian Industrial Conference, and of various Provincial Congresses and Conferences. Here again Japan furnishes us an example. Japan recognised the need and value of a similar institution when she started on her present career.

> "When Iwakura's embassy was in London in 1872, the attention of Mr. (now Marquis) Ito was drawn to the advisability of starting an engineering college in Tokyo to train men for the railways, telegraphs and industries which were to be started in Japan, and he procured, through a Glasgow Professor, the services of Mr. Henry Dyer to organise this college, eventually merged in the University of Tokyo." (*The Educational System of Japan* by W. H. Sharp, 1906, page 206.)

Since then Marquis Ito has repeatedly spoken of the establishment of this College as one of the most important factors in the development of Japan, since from it have come the majority of engineers who are now working the resources and industries of that country. (*Japan by the Japanese*, page 65.) Mr. Dyer was assisted by a number of foreigners to whom Japanese were added as soon as possible. The course then extended over six years, the last two years being spent wholly on practice. The college being under the Public Works Department, the students had the run of all the engineering establishments and works under its control; and graduates who were sent abroad for further work invariably distinguished themselves.

I earnestly hope that with the distressful record, to which our Report bears witness, of all the loss and suffering which India has undergone owing to the want of sufficient and satisfactory provision for technical and technological instruction in this country, the Government will be pleased not to delay any further the institution of an Imperial Polytechnic Institute in India. This is absolutely demanded in the interests of the country and the large recommendations which we make for industrial development.

My colleagues have recommended that there should be at least two imperial colleges established, one to cover every branch of engineering, and the other to be devoted mainly to metallurgy and mineral technology. I think both these departments should be combined in one polytechnic institute, and that all important branches of chemistry should be provided for in the third department. My colleagues have not recommended an imperial college of chemistry, evidently because they have recommended the institution of a separate service for chemistry. Even assuming that a separate service is to be constituted for chemistry, it cannot be accommodated better, for its headquarters, than as a department of the Central Imperial Polytechnic Institute of India.

Under the heading of Miscellaneous Educational Proposals my colleagues refer to the question of providing for training in navigation and marine engineering. I hope this will be done at an early date. I do not share the doubts of my colleagues that the industry of ship-building is not likely to be materialised for some time in India. I hope that, considering the huge volume of import and export trade of India and considering also the indigenous resources for ship-building, with those that exist in the country at present and those that are likely to be developed in the near future, ship-building should be specially encouraged by the Government, even if it should be necessary for some time to import plates and sections from abroad. And for this reason I think that a school should be started in India at an early date to train people in navigation and marine engineering.

Commercial Education.

Among other proposals my colleagues have drawn attention to the importance of commercial education. While appreciating the good work of the Sydenham College of Commerce, they say :—

> "There is a strongly expressed desire for similar colleges in other parts of India, and we think that the other Indian Universities might well consider the possibility of satisfying this demand. Industry and commerce are bound to go on expanding with rapidity, and they will be glad to pay a higher price for more efficient employés."

I entirely agree with this opinion. But I think that in view of the great and growing importance of commercial education, the Government should invite the Universities to establish Commercial Colleges and should help them to do so by substantial grants. I would reproduce here what I wrote in 1911 on this subject :—

> "The importance of commercial education, that is, a special training for the young men who intend to devote themselves to commercial pursuits—as a factor in national and international progress—is now fully recognised in the advanced countries of the West. Those nations of the West which are foremost in the commerce of the world have devoted the greatest attention to commercial education. Germany was the first to recognise the necessity and usefulness of this kind of education. America followed suit; so did Japan; and during the last fifteen years England has fully made up its deficiency in institutions for commercial education. The Universities of Birmingham and Manchester have special Faculties of Commerce with the diploma of Bachelor of Commerce. So has the University of Leeds. Professor Lees-Smith who came to India two years ago at the invitation of the Government of Bombay, in addressing the Indian Industrial Conference at Madras said :—'The leaders of commerce and business need to be scientifically trained just as a doctor or a barrister or professional man is . . . Modern experience shows us that business requires administrative capacity of the very highest type. It needs not merely technical knowledge, but it needs the power of dealing with new situations, of going forward at the right moment and of controlling labour. These are just the qualities which Universities have always claimed as being their special business to foster; and we, therefore, say that if you are going to fulfil any of the hopes which were held out yesterday by your President, if you are going to take into your own hands the control of the commerce of this nation, then you must produce wide-minded, enterprising men of initiative, men who are likely to be produced by the University Faculties of Commerce. The University Faculty of Commerce is intended, of course, to train the judgment and to mould the minds of men. It is claimed that although it must give primarily a liberal education, it is possible to give that education which has a direct practical bearing on business . . . . That kind of man (a man so trained) has immense possibilities in the world of commerce; he is the kind of man on whom you must depend to lead you in the industrial march in the future.' "

When it is remembered that the export and the import trade of India totals up more than 300 millions every year, it can easily be imagined what an amount of employment can be found for our young men in the various branches of commerce, in and out of the country, if satisfactory arrangements can be made to impart to them the necessary business education and training. Here also the experience and practice of Japan afford us guidance and advice. Higher commercial education has made great progress in Japan during the last twenty years. Before the end of the last century the candidates who sought advanced commercial education at the Tokyo Higher Commercial School exceeded a thousand a year, though the school could accommodate a much smaller number then. Since 1901 Higher Commercial Schools have been established at Osaka, Kobé, Nagasaki and Yamaguchi, and at the Waseda University. In banks and other firms, graduates of commercial schools have been employed to an increasing extent every year. 'Formerly it was held that no advanced education was needed for a merchant! But to-day stern reality shows that the management of any large-scale enterprise must be undertaken only by the highly educated.' Experience in Japan has shown that though in the earlier years, the talented youth of the country sought places in official circles, as commerce and industry began to grow even those who had made a special study of politics and law, not infrequently chose to enter the commercial world; and I believe that in view of the industrial development which our recommendations foreshadow, if a College of Commerce is established in every major province of India, a number of our young lawyers, who find the bar overcrowded, will be glad to take advantage of such education and become efficient means of promoting the growth of industry and commerce in the country.

Land Acquisition in relation to Industries.

Section 39 of the Land Acquisition Act lays down that the provisions of sections 6 to 37 (both inclusive) shall not be put in force in order to acquire land for any company, unless with the previous consent of the Local Government, and section 40 of the Act says that—

> " . . . such consent shall not be given unless the Local Government be satisfied, by an enquiry held as hereinafter provided, (*a*) that such acquisition is needed for the construction of some work, and (*b*) that such work is likely to prove useful to the public."

There is no appeal against an order of the Local Government giving its consent to the acquisition of any land on the ground that it is likely to prove useful to the public, and complaint has been made that the power given by the Act to the Local Government has been misused. I know of one instance where this power was used two or three years ago to acquire land to enable the Young Men's Christian Association to establish a club and recreation ground. The protests of the unfortunate house-owners who were dispossessed were unheeded. It cannot be disputed therefore that the section as it stands has been differently interpreted. A remedy may be provided against its being further misinterpreted by having the expression " is likely to be useful to the public " qualified by an amending Act. But however that may be, I do not share the doubt whether that Act can be fairly used by a Local Government on behalf of an industrial company. I think it cannot be.

Nor can I join my colleagues in making the recommendation that the Local Government may acquire land compulsorily from private owners on behalf of an industrial concern, even in the circumstances and under the conditions specified by them. The Indian Act is framed on the analogy of the English Acts on the subject of the compulsory acquisition of land for public purposes. If the expression " likely to be useful to the public " is interpreted in the manner in which it would be interpreted under the English Acts, there will be little room left for doubt as to its meaning. Describing the scope of the Lands Clauses Acts, the Encyclopædia of the Laws of England (Vol. 8, pages 3-6) says :—

> " The provisions as to the incorporation of the Lands Clauses Acts apply to all Acts authorising the purchase of lands whether general or local. Such Acts fall into three classes :—
>
> 1. Acquisition of lands for purposes of national defence or general Government.
> 2. Acquisition of lands for public purposes of a local or municipal character.
> 3. Acquisition of lands by corporations or individuals for commercial purposes of public utility."

Dealing with 3, *i.e.*, Commercial purposes of public utility, it says :—

> "Under this head fall the bulk of the special, local, and personal Acts which incorporate the Lands Clauses Acts. They fall into the following main classes :—
>
> 1. Cemeteries.
> 2. Electric lighting, effected by provisional orders confirmed by statute.
> 3. Gasworks.
> 4. Harbours.
> 5. Markets and Fairs.
> 6. Waterworks.
> 7. Railways and light Railways.
> 8. Tramways.
>
> In all cases, except that of ordinary railways, these undertakings can, under general Acts, be entrusted to municipal bodies."

A glance at the list given above is sufficient to show that every one of the commercial objects for which land may be required is an object of public utility, *i.e.*, one to the benefit of which every member of the public has an equal right with every other member, by complying with the rules which may be prescribed therefor. The test of it is clearly indicated in the last sentence which says that "in all cases, except that of ordinary railways, these undertakings can, under general Acts, be entrusted to municipal bodies." The justification for depriving a man of his property against his will, may be found in the fact that it is being done not for the benefit of any individual or group of individuals, but for the benefit of the public of which he also is a member, and that he will be entitled to share the benefit of the undertaking as much as any other person. Where an undertaking is not "likely to be useful to the public," in the sense indicated above, the provisions of the Act, or the power of the Government, cannot in my opinion be rightly used to compulsorily acquire land for it. In my opinion, when an industrial concern, the members of which have the right to shut out every one outside their body from participation in the benefit of their business, desires to acquire land, it must do so by exchange, negotiation or moral suasion.

Industrial Finance.

We were asked to report in what manner Government could usefully give encouragement to industrial development by direct or indirect financial assistance to industrial enterprises. We are all agreed that the lack of financial facilities is at present one of the most serious difficulties in the way of the extension of such industries, and that it is necessary that much greater banking facilities should be provided than exist at present. We have come to the unanimous conclusion that along with the other measures of assistance which we have to recommend, the establishment of industrial banks, working on approved lines, would be a potent means of removing these difficulties and of affording help to industrialists, and that such difficulties are of sufficient national importance to justify Government assistance. The recent establishment of the Tata Industrial Bank is a matter of sincere satisfaction. But there is need for more institutions of the same class. And it is because we had not sufficient material before us to enable us to formulate a definite scheme for industrial banks, that we have recommended that an expert committee should be appointed at the earliest possible date—

> " . . . to consider what additional banking facilities are necessary for the initial and for the current finance of industries; what form of Government assistance and control will be required to ensure their extension on sound lines as widely as possible throughout the country; and whether they should be of provincial or of imperial scope, or whether both these forms might not be combined in a group of institutions working together."

As the adequate extension of industrial banks will be a matter of time, we have recommended a scheme to meet the need experienced by middle-class industrialists for current finance. I do not quite like the scheme, as it involves too much of spoon-feeding. But as it is professedly a temporary arrangement, I raise no objection to it. I only hope that its acceptance will not in any way delay the adoption of a scheme of regular industrial banks, and that it will be unnecessary to continue this temporary scheme very long.

If industrial development is to take place on anything like the large scale which our Report contemplates, nothing is more important than that regular banking facilities should be multiplied manifold, and that as early as may be practicable. To clear the ground for this it is necessary to remove some misconceptions. Since the failures of certain Indian banks in 1913 and 1914, an opinion has grown up in certain circles that Indians lack the capacity to manage joint-stock banks. When those failures occurred certain foreign papers held these *swadeshi* banks up to ridicule. That there were mistakes both of policy and of management in the case of some of these banks is indisputable. But these mistakes should not be exaggerated, and they should not be made the basis of an indiscriminating condemnation of Indian capacity for joint-stock banking and for extolling the capacity of Europeans for such business. A certain number of failures has been a common feature in the history of joint-stock banking, in England and America as well. Englishmen regard the Bank of England, and with pardonable pride, as the greatest financial institution in the world; and yet even that institution—the safest bank in the whole of the United Kingdom—has had its share of vicissitudes. "From 1819 to 1870, the Bank of England came to the verge of bankruptcy every ten years", (*History of the Bank of England* by Dr. Andreades, page 404), while the list of banks that failed in England is of enormous length. To mention only a few, during the years 1791 to 1818 about a thousand banks suspended operations in England. In the financial depression of 1839, 29 banks went out of existence, out of which 17 had never paid any dividend. In the year 1862 the Limited Liability Law was passed, and within the space of three years 300 companies were formed with a nominal capital of 504 million pounds, of which 270 failed shortly afterwards. This was followed by a financial crisis in which a large number of banks failed, and the greatest of them, Overend Gurney, with liabilities of £18,727,917 closed its doors on the morning of what is known in the history of banking in England, as the Black Friday. Other banks failed also. The estimated liability of the various failures amounted to 50 millions and the losses were also very great. In 1890 the great firm of Baring Brothers, which had helped the Bank of England out of its difficulties in 1839, failed. Have these numerous failures led to any general condemnation of Englishmen as being unfit to manage joint-stock banks? Why then should the failures of a few banks started by Indians lead to any such general inference being drawn against them?

Let us now turn to the history of banking in India. The first joint-stock bank was started in 1770 by Messrs. Alexander and Co. It was called the Hindustan Bank. It issued notes. These notes, though not recognised by the Government, obtained a local circulation which occasionally reached 40 or 50 lakhs. They were received for many years at all the public offices in Calcutta, scarcely excepting the treasury itself. This bank failed in 1832. In 1806 was established the Bank of Bengal, but it received its charter of incorporation in 1809. The East India Company contributed one-fifth of the capital and appointed three of the Directors. Since 1809, and more particularly from 1813, when the Act was passed which removed certain restrictions from Europeans settling in India, banking received a stimulus and several banks were established.

Between 1829 and 1833 most of these agency houses failed. In 1838 a joint-stock bank named the Union Bank was started. It was intended to afford in the money market that facility which the Bank of Bengal owing to its charter could not afford. The bank failed in January 1848, although long before that it was known to be "in a hopelessly insolvent state." "The dividends it declared and of which it made so great a parade were taken not from the capital, for that had gone long before, but from the deposits that people were still confiding enough to make." "The bank had indiscriminately invested in indigo and the Directors freely helped themselves to the bank money." One English firm were debtors to the bank of 24 lakhs of rupees, one-fourth of the whole capital of the bank, and another firm had taken cash credits to the amount of 16 lakhs of rupees. There were scandals connected with the failure of the first Benares Bank in 1849. The Bank of Bengal itself violated its charter in the crisis of 1829-32. The first Bank of Bombay was established in 1840, the Bank of Madras in 1843. These banks were established under conditions similar to those of the Bank of Bengal, with the East India Company as a shareholder of one-fifth of the capital. In 1868 the Bank of Bombay failed. A Commission was appointed to enquire into the causes of the failure. The Report of the Commission, which was published in 1869, ascribed the failure to the following causes:—

> " (*a*) The Charter Act 'which removed many restrictions contained in the former Act and permitted the Bank to transact business of an unsafe character';
>
> " (*b*) 'The abuse of the powers' given by the Act 'by weak and unprincipled secretaries';
>
> " (*c*) The negligence and incapacity of the Directors;
>
> " (*d*) The very exceptional nature of the times."

Sir C. Jackson (President of the Commission) summed up his views on this point in the dictum that:—

> "The great lesson the failure taught was that banks should not lend money on promissory notes in a single name or on joint promissory notes, when all the parties were borrowers and not any of them sureties for others."—(*An Account of the Presidency Banks,* page 31.)

I draw attention to this with special reference to the statement contained in paragraph 284 of our Report that "we have received evidence in favour of a relaxation of the restrictions of the Presidency Banks Act, which prevent loans from being for longer than six months, and require the security of two names."

Another bank of the same name with similar rights, but this time without the contribution of the Government was started in the same year in Bombay. It worked well till 1874, in which year appeared a famine in Bengal. The Government balance at the Bank was one crore, and it was intended that 30 lakhs might be drawn to purchase rice from Burma for the purposes of relief in Bengal. The Bank was unable to pay the money. It did not close its doors only because the money was due to the Government. This incident gave rise to the Reserve Treasury system, which dates from 1876. In this year was also passed the Presidency Banks Act which imposed important limitations on the Banks.

Of the seven European banks that existed in India in 1863, all but one have failed. That one is the Allahabad Bank. About 1875 five new banks were established. Of these only one, *viz.*, the Alliance Bank of Simla, Limited, the Punjab Banking Co. having been amalgamated with it, survives. Amongst those that failed was the Himalaya Bank, Limited, which stopped payment in 1891. Besides these joint-stock banks, the big banking firm of Sir George Arbuthnot ailed in 1907. The Bank of Burma was established in

1904. It failed in 1911. When it failed it had a working capital of a crore and 19 lakhs. It was found that one-third of the working capital had been advanced to a firm in which the Directors were interested. Last of all came the failure of the Bank of Upper India. Indians were not responsible for the management of any of these banks. They were all managed by Europeans.

The history of the Indian banks for which Indians were responsible is neither so long nor so eventful. It goes back only to the year 1881, in which year the Oudh Commercial Bank was founded. It was followed by some other small banks. The Punjab National Bank was established in 1894. Both these banks have carried on their business without interruption. The People's Bank of India was founded in 1901. When it closed its doors in 1913, it had nearly a hundred branches in various places, mostly in Upper India. The other ill-fated institution, the Amritsar Bank, was started in 1904. It failed in 1913. With the year 1905—the year of the partition of Bengal—began an era of new *swadeshi* indigenous activities in India and from 1906 there began to be established banks large and small all over the country. These totalled 476 in 1910. The most important of these were the Bank of India and the Indian Specie Bank, started in 1906, the Bengal National Bank and the Indian Bank of Madras in 1907, the Bombay Merchant Bank and the Credit Bank of India in 1909, the Kathiawar and Ahmedabad Banking Corporation in 1910, and the Central Bank of India in 1911. Of the eleven important banks started since 1901, six collapsed during 1913-14. But taking large banks and small, in all about two dozen Indian banks failed. Though the failure of even one bank is a matter for regret, two dozens out of 476 cannot be said to be a very large number.

There is no doubt that in some of the banks that failed there was a fraudulent manipulation of accounts, and that in others large sums of money were advanced to enterprises in which some of the directors were interested. There were also mistakes of policy, as for instance, in the financing of long-term business with short-term deposits, and the sinking of far too great a proportion of these funds in a single industry. But that the failures were due more to these causes than to dishonesty and fraud is attested by the fact that the number of criminal prosecutions in connection with these failures has been conspicuously small.

Regarding the failures in the Punjab, Pandit Balak Ram Pandya, Auditor of Accounts, Lahore, said in his written evidence submitted to us:—

> "Indeed, when we compare the recent bank and industrial failures in the Punjab with similar incidents in other countries, we are astonished at the comparatively small proportion of cases in which the failures in our case were due to dishonesty or selfishness. The price we have paid for our inexperience is undoubtedly heavy, but it is by no means heavier than what other countries have paid before us. If we have only learnt the lesson which the disasters of the last four years so impressively teach, there is surely no room for despondency."

In pursuance of a recommendation contained in the preliminary note on the scope of enquiry by the Indian Industrial Commission, a Committee was appointed by the Punjab Provincial Industries Committee to examine and report upon the causes of the recent failures in financial and industrial enterprises in the Punjab. Their report throws much valuable light upon the subject. The Committee said:—

> "All the evidence produced before us insisted on the want of business knowledge and experience in company promoters, managers, and staff as a primary cause of failure. There were few competent managers, whether of banks or of industrial concerns. Consequently egregious blunders were made, and some of the so-called dishonesty seems to us very like ignorance; much of it was due to anxiety to cloak losses,"

After describing the defects and mistakes of the banks, the committee said :—

> " Lest, however, it should be imagined that the state of *swadeshi* banking and industry was altogether rotten, we must hasten to point out two relieving features : (*a*) in the first place the survival of the Punjab National Bank showed that a purely Indian directorate and staff were capable of steering a bank through circumstances as trying as ever any financial institution had to face ; (*b*) and again the fact that several banks, as the following statement shows, have paid in full, and others are likely to pay, is evidence that by no means all of the banks were inherently unsound."

(I omit the statement because I understand that much more has been paid up since June 1917, when the Committee made their report.)

The Committee summed up the result of their investigation as follows :—

> "Thus, speaking generally, our feeling is that the collapse can be referred to two fundamental causes :—
>
> (*i*) The inexperience and the defects of the machinery, inevitable to the starting of every new venture ;
>
> (*ii*) The lack of palliation or remedial action such as Government itself, or quasi-Government agencies, *i.e.*, a State-supported Provincial Bank, might supply."

Indians need Government Support and Education in Banking.

This brief review would, I hope, make it clear that there is little ground for any general disparagement of Indians in the matter of joint-stock banking. It shows that if Indians receive (*a*) the same sympathy and support from the Government which Europeans have received through the Presidency Banks, and (*b*) if they also receive the necessary measure of education in modern banking, Indians will give as good an account of themselves in this branch of important national activity as any other people have given. As regards the first, I would strongly recommend that the question of a Central State Bank, having branches in every Province, should be taken up at an early date. The Presidency Banks have rendered inestimable service to Europeans in carrying on trade and commerce with India. They cannot under their existing charter help industries. There has also been a complaint that even in matters of such loans as they can advance, and do advance to Europeans, these banks do not easily accommodate Indians. This complaint found strong expression at Lahore. The Official Committee of Lahore to which reference has been made before, said in their report :—

> " During the crisis there was no co-operation between the Indian banks themselves, or between them and the English banks, or between them and the old-fashioned Indian banks. We attach peculiar significance to the statements made by witnesses as to the position of the Bank of Bengal. While the fact that the Punjab National Bank has been received on the clearing list—only, however, after surviving the crisis—shows that at present good relations do exist and that there is future possibility of better, yet the absence of a provincial bank probably meant the downfall of sound banks which might have been saved. The Bank of Bengal is too big, not local in its sympathy, ignorant of provincial conditions, and not susceptible to the influence of the Provincial Government. The Lahore Branch was willing to help and made recommendations to Calcutta, but these were rejected with curtness, and not even on the deposit of Government paper would the Bank of Bengal consent to advance money to the Punjab National Bank."

When the Government withdrew the right of issuing notes from the Presidency Banks in 1860, they agreed to help them by allowing the use of public balances. In a Finance Department memorandum of 20th December 1860 to the Bank of Bengal (quoted by Mr. Brunyate at page 81 of his " Account of the Presidency Banks ") the extent to which the Government admitted the obligation to compensate the Banks for the withdrawal of the right of issue was indicated as below :—

> "The Bank (of Bengal) cannot be admitted to have any claim *as of right* to compensation, but they are certainly in a position deserving of much consideration and one in which they may equitably look for all reasonable support on the part of Government."

Government agreed to compensate them by giving them their cash balances without interest, to the extent of 70 lakhs to the Bank of Bengal and 50 lakhs to the Banks of Bombay and Madras. In practice the Banks have been allowed to enjoy the use of much larger balances during the decades that have since passed. But as Mr. Brunyate points out in his book at page 99 :—

> "Long before 1876 the Secretary of State had come to the conclusion that the Banks had been sufficiently compensated for the loss of their note issue."

It is high time therefore that the Government should cease to place public balances with the Presidency Banks and that these balances should be kept in a State Bank, the benefits of which would be available to a larger public.

The proposal for a single "Bank of India" to take the place filled by the three Presidency Banks was before the Government between 1860 and 1876. But no decision was arrived at on the subject. The question was taken up by the Royal Commission on Indian Finance and Currency. They expressed no final opinion upon it, but recommended that it should be taken up at an early date. They said in paragraph 222 of their Report :—

> "We regard the question, whatever decision may ultimately be arrived at upon it, as one of great importance to India, which deserves the careful and early consideration of the Secretary of State and the Government of India. We think, therefore, that they would do well to hold an inquiry into it without delay, and to appoint for this purpose a small expert body, representative both of official and non-official experience, with directions to study the whole question in India in consultation with the persons and bodies primarily interested, such as the Presidency Banks, and either to pronounce definitely against the desirability of the establishment of a State or Central Bank in India at the present time or to submit to the authorities a concrete scheme for the establishment of such a bank, fully worked out in all its details and capable of immediate application."

This recommendation was made in 1914. The consideration of it was postponed because of the war. I can only express the earnest hope that it will be taken up as early as may be practicable. The interest of the country demands the early creation of an institution which will at once be the central reservoir to which all public balances should belong and the central fountain which will feed all fruitful national activities throughout the country.

Not the least important advantage of the establishment of a State bank will be that adequate facilities will be provided for training Indians in banking work. The need for such training is obvious. In paragraph 282 of the Report my colleagues say :—

> "But there is in India at present a lack of trained bank employés, owing to the absence in the past of facilities for commercial education and of any regular system of training Indians in banking work, while the country folk do not yet realise the advantages to themselves of organised banking. For these reasons, the extension of banking in the mofussil has been slow. Where, as in the case of the Punjab, too rapid progress was made, it was attended with grave risks and followed by disaster. There was mismanagement at the headquarters of the banks, and many of the branches did little but receive deposits."

The opinion of the Lahore Committee, which I have quoted above, also emphasised the need of promoting a knowledge of banking business. Here again I would draw attention to the marvellous development of banking in

Japan. At the time of the Restoration in 1868 "ignorance concerning the methods of foreign finance, or of banking, or of joint-stock companies was universal, although Japan was not entirely without some financial machinery.' "National Finance and economy were both in a perilous condition." "The Japanese had not been accustomed either to the combination of capital or the formation of corporations. They had undertaken every enterprise individually, and the financial businesses which then existed were not in a prosperous condition." "As early as 1870, Mr. Hirobumi Ito (afterwards Prince Ito), of the Finance Department, memorialized the Government that the proper management of finance and economy was the foundation upon which the State affairs must be conducted, and that unless sound institutions were established for this purpose no good administrative results could be attained." At his suggestion he was sent in the same year to America to study financial institutions and their working. And as the result of his observations he submitted to the Government the following three propositions :—

> "First, the standard of currency should be gold; secondly, bonds should be issued for the conversion of the notes; thirdly, companies should be established for the purpose of issuing paper money."

After much discussion of these and certain alternative proposals, regulations were drafted in 1871 and promulgated with the sanction of the sovereign for organising National Banks. The first National Bank was established at Tokyo in 1873, and began business in less than ten months. It is not necessary for me to trace the history of banking in Japan further than to say that there are now five kinds of banks in Japan, viewed in relation to the line of business respectively followed, *viz.*, (*a*) Home trade, (*b*) Foreign commerce, (*c*) Industry, (*d*) Agriculture and (*e*) Colonisation; and that in 1913 the total number of these banks was 2,152, of which 2,100 represented ordinary and savings banks at the end of the first half-year, and 52 the number of special banks at the end of the year. The paid-up capital of these banks amounted in 1913 to 436,188,271 yen, the reserve fund to 139,109,917 yen, the total deposits to 10,811,884,300 yen.

In "Fifty Years of New Japan" (by Count Okuma, Volume I, page 532) Baron Shibusawa, the President of the First National Bank, concludes his chapter on the development of banking in Japan as follows :—

> "Before concluding this essay, the writer cannot refrain from expressing his profound satisfaction at the fact that the small spring of banking business, which had been so insignificant at the time of the Restoration, has, by a gradual process of accretion, become a broad, navigable river, as it is now, and his conviction that this is the result of having followed the example of European and American nations, to which the Japanese are much indebted. Again the Japanese are very grateful for the valuable services of Mr. Alexander Allan Shand, now a Director of the Paris Bank, London, who came to Japan at the invitation of the Issue Department in 1872, acted as Adviser in banking to that Department, wrote valuable books on banking, instructed young Japanese in that line and thus paved the way for the development of banking business in the country."

India was far ahead of Japan in 1872. She stands far behind Japan to-day. No doubt banking in India to-day is far in advance of what it was in Japan in 1872. But if it is to develope as it should, I would recommend that the Government of India should do even now what the Government of Japan did long ago, *viz.*, take definite steps to impart the best instruction to young Indians in banking through the best teachers it can appoint. Even if a State Bank should be slow in coming, the Presidency Banks and other banks which receive help from Government, should be asked to take in a few Indians—preferably graduates of a College of Commerce—as apprentices for higher training in banking.

Provincial Departments of Industries.

I agree with my colleagues in recommending the creation or development of provincial Departments of Industries, subject to the reservations noted below:—

(1) *Report, paragraph 306 (c).*—I think that the control of technical and industrial education should not be placed under this department but either under the Department of Education or under a committee jointly appointed by the Departments of Education and Industries. In my opinion this arrangement will secure that both the theoretical and practical sides of technical and industrial education will receive sufficient attention.

The proposed multifarious other duties of the Director of Industries will leave him little time to direct the work of education. It is contemplated (paragraph 331 of the Report) that the Deputy Director should inspect institutions for technical education. It will not make for efficiency if the Director is made responsible for duties which he will evidently not be able to perform.

2. *Report, paragraph 307.*—I think that agricultural engineering should be under the control of the Director of Agriculture. Agricultural engineering will not be confined to "putting in power plant for agricultural work." It will include questions relating to drainage and irrigation also. These questions are of far greater importance than the mechanical putting in of power plant, which can be carried out by the engineering staff with no less efficiency if the staff be under the control of the Director of Agriculture than if it be under that of the Director of Industries.

3. *Report, paragraph 312.*—I do not think that the Director of Industries should be the Secretary to Government for commercial and industrial subjects. If he is, the object of referring his proposals to the scrutiny of the Member in charge of the department, will, I fear, be largely defeated in practice. Considering that the Director will deal with large interests, it is desirable that that scrutiny should be real.

4. *Report, paragraph 313.*—The salaries which have been proposed for the Director and the Deputy Director have evidently been proposed from the point of view that these officers will be Europeans. In my opinion the salaries should be fixed from the point of view that they will be Indians, and it should be provided that if a European is imported from abroad, an extra allowance of 25 per cent. above the salary shall be given him. I would suggest that the salary of the Director should be Rs. 1,000 rising to Rs. 2,000.

4. *Report, paragraph 314.*—The salary of the Deputy Director should range from Rs. 500 to Rs. 1,000.

5. *Report, paragraph 317.*—The salary of Circle Officers should range between Rs. 200 and Rs. 500.

6. The strength of the staff should be determined after the Director and Board of Industries have been appointed and have submitted a definite programme of work.

Imperial Department of Industries.

Report, paragraph 321.—I agree with my colleagues in recommending that Industry should have separate representation in the Executive Council of the Government of India.

Paragraph 322.—But I venture to doubt the necessity or desirability of the proposed Indian Industries Board. My colleagues have described the duties for the performance of which the Board is, in their opinion, needed. They say :—

(1) "*The Imperial Department of Industries would control the administration of the various Acts with which it is concerned.*"—The Member for Industry, with his Secretariat, will certainly not require a Board to help him to do this.

(2) "*And (it) would be responsible for the general direction of the accepted industrial policy of the country, including technical and industrial education.*"—Even without any reference to the expected devolution of power to Provincial Governments, the Member for Industry will not require the assistance of a member of the Board to perform this duty either. The Member for Education performs a similar duty in regard to education. In paragraph 352 of the Report my colleagues state what they expect to be done under this head. They say :—

> "Under heads 9 and 10 (Encouragement of industries, advice to Local Governments, and industrial and technical education), the only expenditure incurred by the imperial department would be in respect of the staff of visiting experts, who would work directly under the appropriate member of the Industries Board. The allotment of work among these should be effected by one of them, who might be styled Senior Visitor. The inspectors would be mainly concerned with industrial schools; the inspection on behalf of the imperial department of the higher institutions would be largely performed by members of the Industries Board and other high technical officers."

I think the proposal to appoint these "imperial visiting experts" entirely lacks justification. They will be like the fifth wheel of a coach. But however that may be, all that members of the Industries Board are expected to do in this direction is to inspect "the higher institutions." These institutions will be under provincial Governments. They are not likely to suffer for want of such "superior" inspection, and the Member for Industry may be expected occasionally to honour them by a visit when he is out on tour.

(3) "*The remaining duties of the department would consist of the initiation and running of any imperial pioneer and research factories that may be needed.*" —In paragraph 356 my colleagues say :—

> "As instances of experimental factories which could be more appropriately started by imperial agency may be cited (*a*) glass works, on account of the range of experts needed, (*b*) wood distillation, which would yield results of very general application, and should be applied to a number of different species of trees. It would be for the Industries Board to decide on the best site for the factory in each case, and to determine the exact object of the experiment which should be placed in charge of a suitable specialist."

I do not see any reason why both these suggested factories should not be started as provincial undertakings in any province where conditions may be considered to be suitable for them. But assuming that they *may* be started as imperial factories, surely the Member for Industry, acting on expert opinion and advice, may be trusted to sanction such an experiment without the assistance of the proposed Board.

(4) "*The management of full-scale Government factories.*"—Presumably each such factory will have its manager or superintendent. When many such have been started, the need for appointing a general superintendent of such factories may be considered. But a highly-paid officer like a member of the proposed Board should not be required in connection with this work.

(5) "*The framing of schemes for assisting private enterprise of a class for which an imperial agency would be required.*"—The Member for Industry should be trusted to do this, when it becomes necessary to do it. It should be left generally to the provincial Governments to assist private enterprise

wherever it may be held to be desirable. The policy should, in my opinion, be to avoid creating *a class* of enterprise for which an imperial agency would be required.

(6) "*The supply of stores.*"—For this a very large—perhaps unduly large—staff consisting of a Controller General, four Deputy Controllers, seven Assistant Controllers, six Inspectors, 20 Assistant Inspectors, and a Supervisor of Stores Contracts is proposed. It does not seem that any room is left for work for any member of the Industries Board here.

(7) "*The collection and dissemination of commercial and industrial information.*"—For this also there is a separate highly-paid Director, and it is proposed to give him two highly-paid Deputies for Calcutta and Bombay.

(8) "*And the direction of such scientific and technical services and departments as come under its control.*"—Every imperial service and department which may be constituted will have its appropriate head. With such head it should require little direction from outside. Such direction and general control as may be desirable can be exercised by the Member for Industry.

For all these reasons I think the creation of an imperial *executive* Board of Industries is not necessary. In my opinion an *advisory* Board should be constituted here also, as it will be in the provinces. It may consist of members largely elected by the Legislative Council and partly nominated by the Government. This will mean a saving of over 2 lakhs a year in salaries alone. But not the least important advantage of dropping the proposed Board would be that the Member for Industry would not be left without the charge of any specific branch of work, as he would be under the proposal of my colleagues (paragraph 323). The difficulty that my colleagues have felt in recommending where to locate the Board of Industries (paragraph 328) strengthens the doubt about its necessity. They say:—"We feel compelled to recommend that the headquarters of the Board should be with the Government of India." They "fully realise from the unsatisfactory experience of the past, the imperative necessity of keeping the activities of the Board in close touch with the industrial life of the country." But they think "that this need will be largely met by the fact that the officers controlling the various departments under it would be working in large industrial centres, while the members themselves would also have had considerable industrial experience and would tour regularly." They have also found it "difficult to select an industrial centre as the headquarters of the Board, without introducing a bias that might react unfavourably on other centres." My colleagues have, therefore, reconciled themselves to the idea that the Indian Industries Board should be moving up to Simla and down to Delhi every year with the Government of India. But this does not seem to me to be a business-like arrangement.

Direction of Chemical Research.

I am doubtful as to whether the general direction of chemical research should be left to the Imperial Department of Industries. (Report, paragraph 324.) In my opinion it should be vested in the Faculty of Chemistry of the Chemistry Department of the Imperial Polytechnic Institute, which I have recommended. It seems to me anomalous and unscientific to entrust the direction of scientific research to an executive Government machinery like the proposed Imperial Department of Industries. I fear that the "distinguished chemist," who may be attached to the department, will develope in him more and more of an executive head and lose more and more of the scholar. At present a chemist who has completed an investigation is himself responsible for it and free to publish it. In the scheme proposed this freedom will be taken away from him. The judgment of the Chief Chemist will decide whether the result of any particular research work may or may not be published.

This is the age of specialisation. In order to achieve the highest distinction as a scientist, a man must specialise in some particular branch of science. It will be difficult, if not impossible, to find a chemist, who will be equally strong in more than one branch of chemistry. Generally speaking, the Chief Chemist will not therefore be competent to pass final judgment upon research relating to any branch other than his own. Dr. Bose must be the judge of Dr. Bose. It would be impossible for a man like him to work, when an official, however eminent a scientist he may be in his own particular subject, will have the power to reject or accept his work.

In the note submitted to us by Mr. Puran Singh, of the Dehra Dun Forest Research Institute, he has put forward a strong argument against research under the control of an administrative officer. The considerations urged by him merit attention. He says:—

"(1) Scientific and industrial research when carried on by Government departments does not become as popular as it would be if it were associated with the Universities.

"(2) The work of the University professor, unlike that of the Government official, is open to public criticism and valuation not only at the hands of laymen but before the other Universities of the world. This accounts for the high standard of University work, a standard which it is the pride of the professor to maintain, not only for the sake of his own good name, but for the reputation of the University to which he belongs. A Government official, on the other hand, has to keep a limited circle satisfied with his work, and his reputation when once made in that circle, runs little risk of being marred, as he is safe under the protection of his official seat.

"(3) Up to this time in no country which encourages scientific research has it been possible for any one to aspire to the dignity of a professor of a University without having first risen through the ranks of student and assistant. On the other hand, in this country we see young men fresh from Universities appointed direct to responsible positions of research and educational work, and the stimulus for ever-increasing effort is in most cases lacking.

"(4) Research work by the agency of a Government department as such does not carry sufficient weight with the scientific bodies of the world.

"(5) The research officer should be in the nature of a democratic public man rather than a Government official, who is bound to become by the very nature of his environment somewhat of an autocrat.

"(6) Many public research institutes that have recently sprung up in this country indicate a desire on the part of the people to be rid of official control in order to carry on research as independently as is at present done in the Universities of other countries. Though the desire is thus indicated, yet all work in this direction is waste of energy if there exists no clearly defined and harmonious co-operation between Government and these private institutes. Such institutes are bound to starve finally through the lack of the University atmosphere, and the authority and resources, as distinct from control, of the Government at their back. The Universities of Tokyo and Kyoto have both the Government and, through the Government, the people at their back.

"(7) Education when given in colleges run by a Government department such as those of Agriculture and Forests, as distinguished from colleges affiliated to Universities, does not tend to efficiency. The teacher therein is neither properly responsible to the students and the public nor to the Government. This is because the Government has no means of judging the ability of the professor as such. The fact that no Government selection till now has proved a failure in research or in imparting scientific education is due to Government having unwittingly lent to them an authority and position which causes men of average attainments to appear as geniuses.

"(8) And lastly, it is a fact that no country in the world has followed the procedure adopted in this country for organising scientific and industrial research. This point is well illustrated in a recent number of "Nature" by Mr. Hugh Robert Mill, in reviewing "a note on an enquiry by the Government of India into the relations between forests and atmospheric and soil moisture." He says :—'To our mind the method adopted could produce no better result than it appears to have done. In a scientific problem such as was set forth, the only function of the State seems to us to be to decide that such an enquiry shall be carried out at the public expense and that every facility for obtaining data shall be given by all the departments and all the Government concerns, local and central. It should then be handed over to a competent man of science, set free from all other duties and supplied with necessary assistants. His report, when complete, will be authoritative and epoch-making, if not final, and incidentally his own reputation would be made or marred by his handling of the facts. The total expense would probably be no greater and the labour of many public servants would not be diverted from the work for which they were trained.'

"This comment emphasises exactly the point I am attempting to bring to your notice, *viz.*, that scientific research must be independent and in the hands of the best possible men."

I would therefore recommend that the control of research should be left not to the Imperial Department of Industries but to the Imperial Polytechnic Institute, if it is established, or to a Science Council elected by scientists working in the various Universities, Colleges and other scientific institutions in the country. The Departments of Industries, both provincial and imperial, should communicate their suggestions for research to the Institute or Council, and encourage the application of the results of researches made to industries, so far as they can.

The Organisation of Scientific and Technical Services. The Indian Chemical Service. The Imperial Industrial Service.

In proceeding to discuss the important proposals of my colleagues in relation to the subjects noted above, I think it necessary to recall that the Commission was appointed "to examine and report upon the possibilities of further industrial development in India and to submit its recommendations with special reference to the following questions :—

(*a*) whether new openings for the profitable employment of Indian capital in commerce and industry can be indicated;

(*b*) whether, and, if so, in what manner, Government can usefully give direct encouragement to industrial development—

- (*i*) by rendering technical advice more freely available;
- (*ii*) by the demonstration of the practical possibility on a commercial scale of particular industries;
- (*iii*) by affording, directly or indirectly, financial assistance to industrial enterprises; or
- (*iv*) by any other means which are not incompatible with the existing fiscal policy of the Government of India."

In concluding the resolution appointing us, the Government of India expressed the hope that the Commission would "find it possible to place their report in the hands of the Government of India within 12 months from the date of its assembling in India." This as well as the terms of our reference would show that we are expected to make recommendations as to openings for the profitable employment of Indian capital in commerce and industry, which could be carried out at an early date.

Chapter III of our Report which gives a summary of the industrial deficiencies of India, shows how various and how great are the openings in which Indian capital can be employed. We say there :—

"The list of industries which, though their products are essential alike in peace and war, are lacking in this country, is lengthy and ominous. Until they are brought into existence on an adequate scale, Indian capitalists will, in times of peace, be deprived of a number of profitable enterprises; whilst in the event of a war which renders sea transport impossible, India's all-important industries will be exposed to the risk of stoppage, her consumers to great hardship, and her armed forces to the greatest possible danger."

But as my colleagues say at page 4 of our Report—

> " . . . although much information of technical and industrial value will be found in the evidence of some of the expert witnesses . . . we have concentrated our attention on the machinery which we propose should be set up to effect industrial development generally rather than on the particular industries to be improved. This machinery will, we believe, do what is needed for all industries and it would be useless for us to attempt to frame detailed recommendations for which technical enquiries by experts are required."

With due deference to my colleagues, I think that we have concentrated too much attention on the machinery which has been proposed and yet, I fear that, excepting the provincial and imperial Departments of Industries, the machinery proposed will not promote industrial development as rapidly as the circumstances of the situation require. The scientific and technical services which they recommend will, on their own showing, take some time to organise, the industrial researches which they wish to promote, will take some time to bear fruit. In my opinion the immediate requirements of the country in the matter of industrial development, require the adoption of measures which will bear fruit more speedily.

There are two classes of industrial enterprises which can be taken up in this country. The first class, and this is by far the larger class, consists of those which can be started by the importation of machinery and experts as first managers. In this class of work we have to imitate and not to initiate. As soon as the provincial Departments of Industries, with their Advisory Boards, have been constituted in the provinces, they should decide, with such expert advice as may be necessary, what industries of this class can be started within the province, and should invite and encourage Indian capitalists by information and technical assistance to organise them. It was the adoption of such a course that enabled Germany and Japan to achieve rapid industrial development. Sir Frederick Nicholson urged the adoption of this course on us in the following passage in his note :—

> " On the whole, then, I consider that the best way both for starting selected industries in India and for training the future managers is, after the fashion of Germany and Japan and other countries, for the promoters, whether Government or private, to draw liberally on Great Britain, etc., for real experts as first managers of any projected industries ; then to select young men, preferably men already trained in technological institutions, and to put them through close disciplined, industrial and business training under these experts till they are fitted either to start on their own account or as reliable business managers to capitalists."—(Minutes of Evidence, Vol. III, pages 396-397.)

Mr. Charles Tower also says :—

> " In the manufacture of steel ware and of machinery, Germany is usually credited, not without justice, with being rather an imitator than an initiator. Her great success in this line has been achieved by the rapidity with which Germany had adopted the improvements invented elsewhere." (*Germany of To-day*, Home University Library, page 173)

This is also the course which was adopted by America. Up to 1860 America had made little progress in developing the manufacture of steel. In 1862 Park Brothers and Company imported the biggest crucible steel plant of all up to that time, and imported also several hundred English workmen to ensure success. Since then the progress of the steel industry there has been phenomenal. In 1860 the output of pig iron in the States was only 0·8 million tons, and of steel nil; by 1900 America was producing 13·7 millions of tons of pig iron and 10·1 of steel, and in 1913 while the production of pig iron amounted to 10·3 million tons in the United Kingdom, it amounted to 31 million tons in the United States. Last but not least, we have an eloquent illustration in India itself of the soundness of this policy in the success of the Tata Iron and Steel Works. The works were organised with the advice, and have been carried on under the supervision of the best experts imported from abroad, and they have been a conspicuous success. This, therefore, is the right policy which should be followed in regard to the many other industries the need for which has been pointed out in our chapter on the industrial deficiencies of India. Raw materials and labour abound, capital exists and only wants organising, the home market is extensive, the machinery and the expert can be imported, the profits to the Government and the people will be considerable; all that is needed is that the Government should whole-heartedly lead and assist Indian capital in organising the industries.

But to carry out industrial development in this wise it is essential, as Mr. H. P. Gibbs, the General Manager of the Tata Hydro-Electric Supply Company, so well put it in his written evidence before us, that—

> " . . . . no man should be imported into India unless he is a recognised expert in his particular line. He too should be engaged on short-time contract and made to understand he is being engaged and paid to teach our local men just as much as to introduce and carry on his work. The young man from abroad who is educated but inexperienced should not be brought to India and allowed to get his practice here."

The industries which will be so started will be the best practical schools for training our science graduates as recruits for the proposed imperial services.

Provision for Scientific Research.

The second class of industries consists of those for which some research work is needed. I fully agree with my colleagues about the need and value of such research. I recognise that, to borrow the language of the Committee of the Privy Council, " effective research, particularly in its industrial applications, calls increasingly for the support and impetus that come from the systematised delving of a corps of sappers working intelligently, but under orders." I am therefore not opposed to the idea of creating an Indian Chemical Service and an Imperial Industrial Service at the right time and under the right conditions. But I regret I do not agree with my colleagues as to the time when, and the conditions under which, these services should be organised. In my opinion our first duty is to create the material for these services in this country. One important means of doing this is the starting of industries, as I have urged above, under imported experts and placing our select young men, already trained in technological institutions, under them. The other measures which in my opinion are needed are—

(*i*) that steps should be immediately taken for developing the teaching of science and technology in our existing Universities and other collegiate institutions, (*a*) by strengthening their staff and equipment, and (*b*) by awarding a sufficiently large number of scholarships to encourage the study of science and technology at our schools, our colleges and our Universities;

(*ii*) that an Imperial Polytechnic Institute, manned by the most distinguished scientists and engineers, whose co-operation we can secure, should be established in the country, for imparting the highest instruction and training in science and technology; and

(*iii*) that the provision of scholarships for study in foreign countries should be largely increased to enable the most distinguished of our graduates to finish their education in the best of foreign institutions.

The view which I humbly urge here is strongly supported by the recommendations made in the "Interim Report of the Consultative Committee on Scholarships for Higher Education," of which the Right Hon'ble Mr. A. H. Dyke Acland was the Chairman. The Committee was appointed before the war in March 1913. The report from which I am going to quote was adopted by it in May 1916. In a prefatory note to the Report, Sir Amherst Selby-Bigge, writing on behalf of the Board of Education, said:—

> "The Board have no need to use complimentary phrases to convey their estimation of the great value of their work, but on this occasion they may perhaps permit themselves to express their appreciation of the broad spirit in which the report is conceived, of its forcible exposition of principles, and of the lucid and vigorous style in which it is written."

The recommendations are of such great weight and have such a direct bearing on the question I am dealing with, that I make no apology for reproducing them here:—

> "On the side of science and technology in relation to the industries and commerce of the nation, the greatest needs of the nation are ranged by us in order of practical priority as follows, though their satisfaction should proceed as far as possible contemporaneously and concurrently.
>
> "(129) The first need is the wider recognition, especially by employers, of the benefits that can be obtained by the employment in industry, agriculture, and commerce, of men trained in science—in all grades, but specially for directive and advisory posts. A great improvement is already seen; but public opinion needs further enlightenment.
>
> "(130) Secondly, the most useful thing that can be done without any increase in the means at present at our disposal is to encourage research in existing institutions after graduation. There were probably before the war more men and women fitted to be trained in research than were secured for this public service. The prolongation of scholarships in suitable cases, which we recommend, is one means that is available; other means fall within the province of the Committee of the Privy Council.
>
> "(131) Given a limited amount of money available annually, the next need would be to assist existing institutions for training in science and technology, to enable them to improve their equipment, increase their staff, attract more highly qualified teachers, and introduce new subjects of study; and to establish new places of higher technical and scientific instruction where needed. To bring existing institutions fully up to national needs a great capital sum and income would be required. But any sum, well expended, would be useful. However, in view of the needs of the nation and the empire, it seems probable that the larger sum will be forthcoming, at whatever sacrifices in the immediate future.
>
> "(132) Improved and extended higher secondary education is needed. Side by side with this, with the strengthening of Universities and technical schools, and with an increasing demand for scientific workers, an increase in the supply of scholarships from secondary schools and Universities will be required. This should move forward *pari passu* with other improvements." (Pages 69 and 70).

This view also receives support from the conclusions at which the Committee of the Privy Council for Scientific and Industrial Research arrived. In their Report for the year 1915-16 (pages 40 and 41), they summarised those conclusions as follows:—

> "If we were asked to state these conditions (that appear to us necessary for the success of our work) in the shortest possible terms we should reply: First, a largely increased supply of competent researchers; secondly, a hearty spirit of co-operation among all concerned, men of science, men of business, working men, professional and scientific societies, Universities and technical colleges, Local Authorities and Government Departments. And neither condition will be effective without the other.
>
> "Before the war the output of the Universities was altogether insufficient to meet even a moderate expansion in the demand for research. The annual number of students graduating with First and Second Class Honours in science and technology (including mathematics) in the Universities of England and Wales before the war was only about 530, *and of these but a*

> *small proportion will have received any serious training in research.* We have frequently found on inquiry that the number of workers of any scientific standing on a given subject of industrial importance is very limited.
>
> "The responsibility for dealing with the grave situation which we anticipate, rests with the education departments of United Kingdom. We shall be able to do something to encourage a longer period of training by the offer of research studentships and the like; but that will not suffice. It is useless to offer scholarships if competent candidates are not forthcoming, and they cannot be forthcoming in sufficient numbers until a larger number of well educated students enter the Universities. That is the problem which the education departments have to solve, and on the solution of which the success of the present movement in our opinion largely depends."

Recruitment of the Scientific Services.

For the recruitment of the scientific services, the Indian Chemical Service, and others, my colleagues recommend that—

> " . . . to the utmost extent possible the junior appointments should be made from science graduates of the Indian Universities, and that the senior and experienced men who will be required to initiate and direct research work should be obtained on special terms from England, *when such are not available here.*"

The qualifying clause which I have emphasised, must be appreciated at its practical value. My colleagues recognise that a "relatively small field of selection at present exists in India." They say :—

> "As development of science teaching at the Universities proceeds, and opportunities for technical training in India increase, we believe that the necessity for importing specialists will greatly diminish, and that ultimately the services will be mainly filled with officers trained in this country."

But they say further on that "it will be some years before it will be possible to obtain the full necessary staff in India."

They therefore rely for such recruitment mainly on England. But they recognise that—

> " . . . there will be similar post-war demands made at home and in the dominions for scientific, especially chemical, experts, which will render it difficult to obtain suitable recruits from England. It is probable, consequently, that salaries higher than the pre-war rates will be demanded by suitably qualified experts."

But I think that qualified English experts will not be available, at any rate in any number for some years even for higher salaries than those of the pre-war period. The Committee of the Privy Council said in their Report for 1915-16 :—

> "It is in our view certain that the number of trained research workers who will be available at the end of the war will not suffice for the demand that we hope will then exist. We are apt to forget in this country that with industry as with war, a brilliant group of field officers, and even a well-organised general staff, need armies of well-trained men in order to produce satisfactory results."

In view of these facts, it will be wise of us not to rely upon our being able to indent on England for the "senior and experienced men who will be required to initiate and direct research work in India." Besides, though they advocated that "senior and experienced men" should be obtained from England, what my colleagues have actually proposed is very different from it. They have proposed that "recruits for these services—especially chemical services—should be obtained at as early an age as possible, preferably not exceeding 25 years." They leave no room for doubt as to what they mean. They say :—

> "We should thus secure the University graduate, who had done one or perhaps two years' post-graduate work, whether scientific or practical, but would not yet be confirmed in specialisation . . . We assume that the requisite degree of specialisation will be secured by adopting a

system whereby study leave will be granted at some suitable time after three years' service when a scientific officer should have developed a distinct bent."

In their recommendations regarding the recruitment of the Imperial Industrial Service also, they say that " the age of recruitment should not usually exceed 25 years," and that they think it desirable, " if the young engineers whom we propose to recruit are to develope into valuable men, that they should be encouraged after about three years' service to take study leave." It is obvious then that under the scheme proposed by my colleagues the men to be recruited from England will not be "senior and experienced men" but raw graduates from Universities who will be expected to specialise after joining the service in India. Specialisation almost always involves delay. If therefore we must take in only raw graduates and remunerate them during the years they are qualifying themselves for effective research work, I think it is very desirable that we should take in Indian graduates whose training will be less costly, and who will serve the country throughout life, whereas in the case of an English graduate, there will always be the apprehension that he may leave us for higher emoluments elsewhere, and the certainty that he will leave the country after the period necessary to qualify for a pension, taking away with him the knowledge and experience which he had gained in its service. Having regard to all the considerations which have been urged above, I think the idea of recruiting this service from England should be abandoned, and that it should be decided that it shall be recruited entirely from among graduates of the Indian Universities and of the Imperial Polytechnic Institute, which I have recommended.

My recommendation has the further merit of being entirely in consonance with the recommendations made by the Royal Commission on the Public Services in India regarding the recruitment of scientific and technical services. Indians have a very sore feeling about the imperial Indian services. The importation of experts from England for these services has not only unnecessarily increased the cost of these services to India but has had the very great disadvantage of preventing Indians from being trained for higher work in these services. We can never forget that so distinguished an Indian as Dr. P. C. Roy did not find admission into the Indian Educational Service. We know that though the Geological Survey of India has been in existence for 64 years, up to 1913 only three Indians had been appointed to the superior service in it. In this connection I put the following question to Dr. H. H. Hayden, Director of the Geological Survey of India :—

> " Has the department kept it as an object before it that it should train Indians to qualify themselves for employment in the higher grades of the department ?"

And his answer was :—

> " We have been for many years training men in the subordinate ranks of the department, but they do not necessarily qualify for appointments in the higher grade. It is always open to them to apply for an appointment in that grade . . . "

My Hon'ble colleague Mr. Low then asked Dr. Hayden :—

> " You have these research scholars. Is it not one of the objects of research scholarships, that the scholars, if possible, should qualify themselves for recruitment to the department ?"

And the answer was :—

> " That is one of the objects of the efforts we have made in educating them in geology in the Presidency College and the Calcutta University. I think geological education was initiated in Calcutta by the Geological Survey. We have had more Indians in the subordinate branch of the service."

The Indian witnesses before the Royal Commission quoted the opinion of Dr. Oldham, the first head of the Geological Department, concerning the fitness of Indians for this department, which showed that he had "the most unshaken confidence that with even fair opportunities of acquiring such knowledge (that of the physical sciences) many Indians would be found quite competent to take their place side by side with European assistants either on this survey or in many other ways," and yet the evidence before the Royal Commission showed that competent Indians had found the door of admission barred against them and that, up to 1913, only three Indians had been appointed to the superior service.

My colleagues say that the ultimate object should be to man the services they propose with officers trained in this country. Similar language was used in the past in relation to other imperial departments. For instance, it appears that in the Agricultural Department the intention of the Government of India from the very commencement was that it should be staffed largely by Indians.

> "We adhere firmly," wrote the Government of India to the Secretary of State in 1910, "to our frequently declared policy that the service (the Agricultural service) should be manned ultimately by Indians and that the object to be kept steadily in view is to reduce to a minimum the number of experts appointed from England and to train up indigenous talent so as to enable the country to depend on its own resources for the recruitment of its agricultural staff in higher branches."

But in spite of this clear declaration, the Imperial Service has become the monopoly of Europeans, while Indians have been confined to the Provincial Service. The evidence of Dr. Harold Mann and of the representative members of the Provincial Service before the Royal Commission showed that many highly qualified Indians, several of whom possessed European degrees or experience, had been unable to find admission into the Imperial Service, which had been manned by recruits imported from Europe, who, said Dr. Mann, laboured under the serious disadvantage that their experience related to a system of agriculture "which in its organization is quite foreign to most parts of India and will be for a long time to come."

So also with regard to the Imperial Forest Service. The Inspector General of Forests stated in his evidence before the Royal Commission that—

> " . . . when the Forest Department was instituted, and for a long time afterwards both the Government of India and the Secretary of State expressed the opinion that it was a special department in which the service of Indians should be utilised as largely as possible."

Yet from 1891 to 1906 no steps were taken to provide for direct recruitment to the Provincial Service, and it was laid down in 1912 that candidates for the Imperial Forest Service "must have obtained a degree with honours in some branch of natural science in a University of England, Wales or Ireland, or the B.Sc. degree in pure science in one of the Universities of Scotland." At the time the Royal Commission took evidence, the total number of officers in the superior service in the Agricultural, Civil Veterinary, Forest, Geological Survey, Locomotive and Carriage and Wagon Departments was 407. Of these only six officers were statutory natives of India!

The Royal Commission recognised the injustice that had been done to Indians in their practical exclusion from the scientific and technical services. They expressed the opinion that there were no political grounds whatsoever for recruiting the superior staff of such services in Europe. They stated that if the requisite technical training were available in India, the necessity for indenting on Europe for qualified men would cease to exist, and they therefore recommended that "a determined and immediate effort" should be made to bring about conditions which would soon make it possible to meet the normal requirements of the services without requisitioning the services of men from abroad. That effort remains yet to be made; and while my colleagues have proposed the creation of two more imperial services they have recommended that the establishment of the Central Chemical Research Institute and of the Imperial Engineering College may wait for an indefinite future. These facts, coupled with the experience of the past, make me apprehend that, if these two services are created on the lines suggested by my colleagues, the senior appointments in them also will for a long time remain practically the monopoly of Europeans, and that Indians will not only be kept out of their emoluments, but also of the opportunities for acquiring high efficiency in the subjects with which the services will be concerned. The Royal Commission recommended that with a view to bring about the conditions which would soon make it possible to meet the normal requirements of the services without requisitioning the services of men from outside, existing institutions should be developed or new ones created and brought up to the level of the best European institutions of a similar character. They recognised that "this would require an initial expenditure of a considerable sum of money," but they urged that "the outlay would be more than repaid, not only by the additional facilities which such institutions would give to young men to qualify themselves for direct appointment, to the higher branches of the public services, but by the contribution they would make to the industrial progress of the country." These recommendations lend strong support to my proposal that a first-class Polytechnic Institute should be established in India as one of the first measures needed for the industrial development of the country. At such an institute provision should be made for imparting the highest instruction and training in all the important branches of science and technology, and also in commerce and administration. This will be the best means of creating the army of trained workers which is needed for promoting industrial development in this extensive empire. The institution of the proposed services should wait until this has been done. And in the meantime only such appointments should be made in the Departments of Industries as it is absolutely necessary to fill.

The Estimate of Cost.

The proposals which we have made in the Report show that the number of technically trained men who will be needed to carry on industrial development and to promote the trade and commerce of the country, will be a very large one, and that it will grow steadily for some time. It is also certain that public expenditure will rise in several directions after the war. These considerations demand that expenditure should not be raised in any department beyond what is actually necessary. The salaries which my colleagues have proposed for the Imperial Industrial and the Indian Chemical Services are largely based upon a consideration of what is likely to attract Englishmen to the senior appointments in the services. If, in view of all that I have urged above, the decision should be arrived at that these services should be manned by Indians, including in that term those Europeans who are statutory natives of India, the proposed expenditure would be largely reduced. This is no mean consideration and should not be ignored. Situated as India is, one cannot too often recall the wise remarks of Sir William Hunter, made many years ago, that—

> " . . . if we are to give a really efficient administration to India, many services must be paid for at lower rates even than at present. For those rates are regulated in the higher branches of the administration by the cost of officers brought from England. You cannot work with imported labour as cheaply as you can with native labour and I regard the more extended employment of the natives, not only as an act of justice but as a financial necessity. . . If we are to govern the Indian people efficiently and cheaply, we must govern them by means of themselves, and pay for the administration at the market rates for native labour."

Should this view be accepted, the salaries proposed would be reduced by about 30 to 40 per cent.

I do not attempt to make any detailed alternative proposals regarding the cost of the scheme. If any of my suggestions commend themselves to Government, the details will easily be worked out.

Speaking generally, I would say that a substantial part of the expenditure that is proposed for salaries should be saved, partly by reducing the number of appointments proposed and partly by fixing the salaries at the standard which will be suitable for Indian graduates and scholars. The expenditure proposed on buildings will also, in my opinion, admit of a very substantial reduction. Here again the example of Japan affords us guidance. They spend very much less on their educational buildings than is spent in India. A scheme for the award of scholarships to encourage the study of science and technology can be best prepared by the Education Department.

As regards grants to Universities, I would recommend that on an average an annual grant of a lakh and a half should be made to each University for the purposes of providing instruction and teaching in science and technology, particularly in mechanical and electrical engineering, applied chemistry, commerce and agriculture. A capital grant of about 15 lakhs each should be made for the necessary educational buildings and residential quarters and for equipment. And lastly, I would recommend that, to start with, a capital expenditure of 30 lakhs and an annual grant of 6 lakhs a year should be sanctioned for an Imperial Polytechnic Institute.

Conclusion.

I cannot conclude this note better than by endorsing the following generous and wise words of Sir Frederick Nicholson :—

> "I beg to record my strong opinion that in the matter of Indian industries we are bound to consider Indian interests firstly, secondly and thirdly.—I mean by 'firstly' that the local raw products should be utilised, by 'secondly' that industries should be introduced and by 'thirdly' that the profits of such industry should remain in the country."

If measures for the industrial development of India are taken in this spirit, India will become prosperous and strong, and England more prosperous and stronger.

MADAN MOHAN MALAVIYA.

APPENDICES

APPENDIX A—1.

No. 3403.

GOVERNMENT OF INDIA.

DEPARTMENT OF COMMERCE AND INDUSTRY.

(INDUSTRIES.)

RESOLUTION.

Simla, the 19th May 1916.

The Government of India, as announced by Sir William Clark when speaking on Sir Ibrahim Rahimtoola's Resolution in the Legislative Council on 21st March 1916, have decided that the time has come when the question of the expansion and development of Indian manufactures and industries should be taken up in a more comprehensive manner than has hitherto been attempted. India possesses two notably successful manufacturing industries in the two great textile industries of cotton and jute, and there are others which have also reached some degree of importance; but it remains none the less true that she is still in the main a producer of raw materials. The Government of India have strong hopes, however, that it may prove possible to place the industries of this country on a much firmer and more extended basis than at present, and they consider that no means should be left untried which holds out a reasonable hope of effecting this end. They are aware of the eager desire of a large number of the people of India for the industrial development of their country, and with this desire the Government of India fully associate themselves.

The efforts of Government in the past towards this end have disclosed the existence of numerous difficulties. Indian capital is timid and unenterprising; skilled labour is lacking; and there is a want of practical information regarding the commercial potentialities of India's raw products. All these difficulties require full examination by men of technical experience and high business standing. The Government of India have, therefore, decided to appoint a Commission, some of whose members will be acquainted with Indian conditions, some with industrial progress in other countries where similar objects have been pursued, and others with industrial problems generally and their business side in particular. The Government of India are well aware that there are special difficulties in the way of such an enquiry during war time, but after full consideration it has been decided to appoint the Commission at once in order that, when after the close of the war the financial position is once more established on a normal basis, the Government may be able without further delay to take such action as may seem suitable after considering the Commission's recommendations.

2. In framing the terms of reference it has been found necessary to exclude two matters from the scope of the Commission's labours. In the first place, any consideration of the present fiscal policy of the Government of India has been excluded from its enquiries. When introducing the Financial Statement in the Legislative Council, the Honourable Finance Member, it will be remembered, stated, in connection with the question of the cotton duties, that the general fiscal relationship which exists between the various parts of the Empire and other countries must, in the opinion of His Majesty's Government, be reconsidered after the war, and that in the meantime they wish to postpone any action that would tend to raise such questions. The same considerations apply with even greater force to any proposals involving the imposition of duties for the specific purpose of protecting Indian industries, a policy which would very directly affect the fiscal relations of India with the outside world. In the next place, it is not proposed that the Commission should re-examine those aspects of technical and industrial education which have recently been dealt with by Committees working in England and India whose reports are at present under the consideration of the Government of India.

3. Subject to the above qualifications, the Commission will be instructed to examine and report upon the possibilities of further industrial development in India and to submit its recommendations with special reference to the following questions:—

(*a*) whether new openings for the profitable employment of Indian capital in commerce and industry can be indicated:

(*b*) whether and, if so, in what manner, Government can usefully give direct encouragement to industrial development—

- (*i*) by rendering technical advice more freely available;
- (*ii*) by the demonstration of the practical possibility on the commercial scale of particular industries;
- (*iii*) by affording directly or indirectly financial assistance to industrial enterprises; or
- (*iv*) by any other means which are not incompatible with the existing fiscal policy of the Government of India.

The Government of India trust that the Commission will find it possible to place their report in the hands of the Government of India within 12 months from the date of its assembling in India.

4. The Commission will consist of the following gentlemen:—

PRESIDENT.

1. SIR T. H. HOLLAND, K.C.I.E., D.Sc., F.R.S.,
President of the Institution of Mining Engineers.

MEMBERS.

2. MR. ALFRED CHATTERTON, C.I.E., B.Sc., F.C.G.I.,
A.M.I.C.E., M.I.M.E.,
Director of Industries and Commerce in Mysore.

3. THE HON'BLE SIR FAZULBHOY CURRIMBHOY EBRAHIM, KT.,
Messrs. Currimbhoy Ebrahim and Company, Bombay.

4. MR. EDWARD HOPKINSON, M.A., D.Sc.,
Managing Director, Mather and Platt, Manchester, and
Deputy Chairman, Chloride Electric Company.

5. THE HON'BLE MR. C. E. LOW, C.I.E., I.C.S.,
Secretary to the Government of India, Department of
Commerce and Industry.

6. THE HON'BLE PANDIT MADAN MOHAN MALAVIYA, B.A., LL.B.,
of Allahabad.

7. SIR RAJENDRA NATH MUKERJI, K.C.I.E.,
Messrs. Martin and Company, Calcutta.

8. THE RIGHT HON'BLE SIR HORACE CURZON PLUNKETT,
P.C., D.C.L., LL.D., F.R.S., K.C.V.O.

9. THE HON'BLE MR. F. H. STEWART, C.I.E.,
President, Bengal Chamber of Commerce.

10. SIR DORABJI JAMSETJI TATA, KT., J.P.,
Messrs. Tata, Sons and Company, Bombay.

The Secretary will be appointed later.

Ordered that a copy of this Resolution be forwarded to all Local Governments and Administrations, with the request that the Commission may be given any assistance which they may require and that any applications for information which may be made by the Commission may be complied with.

Ordered also that a copy of the Resolution be forwarded to all Departments of the Government of India, to the Director-General of Commercial Intelligence, to the President and Members of Commission, and that the Resolution be published in the *Supplement to the Gazette of India.*

C. E. LOW,
Secretary to the Government of India.

APPENDIX A—2.

PRELIMINARY NOTE ON THE SCOPE OF ENQUIRY BY THE INDIAN INDUSTRIAL COMMISSION.

I.—INTRODUCTION.

1. The scattered information already available regarding the resources of India in raw material, the suitability of the people for expert labour, and the probable financial resources of

the country, is sufficient to show that there are room and opportunity for a very substantial development of manufacturing and other industries.

2. It will be the business of the Commission, after establishing the fundamental proposition by a critical analysis of the facts, to suggest the most profitable lines of action with the object—

(*a*) of drawing out capital now lying idle;
(*b*) of building up an artisan population;
(*c*) of carrying on the scientific and technical researches required to test the known raw materials and to design and improve processes of manufacture;
(*d*) of distributing the information obtained from researches and from the results of experience in other countries; and
(*e*) of developing the machinery for—
  (1) financing industrial undertakings, and
  (2) marketing products.

3. As the result of the examination of Government records and preliminary discussion with various authorities, the following suggestions have been made regarding problems likely to come before the Commission. These suggestions are now being distributed among the Local Governments with a view of obtaining further suggestions during the current monsoon tour.

4. The President will be grateful for any suggestions in addition to, or in modification of, those given below, in order that, at the end of the monsoon, it will be possible to sketch out a tour programme for the Commission, and to frame a list of questions for the assistance of witnesses.

II.—COLLECTION OF PRELIMINARY INFORMATION.

5. The Commission will assemble during October next, and, as soon as possible afterwards, will proceed by touring through the provinces, to collect evidence through independent witnesses, representatives of local Committees and institutions, and by personal inspection of industrial enterprises.

6. In view of the limited time at the disposal of the Commission, it would be an advantage in each of those provinces not already provided with a Director of Industries or an Advisory Board, to organise at once a representative Committee assisted, if practicable, by an officer on special duty. Steps to this end have already been taken by some of the Local Governments.

7. These representative Provincial Committees would be responsible for giving precision to questions that are now being discussed vaguely in general terms, for example, by stating them for concrete cases. The Provincial Committees would compile lists of raw materials available locally and suitable for the establishment of new industries, and also lists of raw materials that might be imported as accessory material, or even as the principal raw material with the same object. From this and other information at their disposal, they would form lists of industries already tried or new, that appear to be suitable for encouragement according to the special circumstances of each province, calling attention to enterprises that have been obviously successful or offer distinct promise of success. They might profitably make detailed and, when necessary, confidential studies of a few typical examples of recent failures, in order that the causes which have contributed to such failures may be brought to the notice of the Commission. They would also advise the Commission as to the names of suitable individual or representative witnesses.

8. It is suggested that, during the next cold weather tour, the time at the disposal of the Commission in each province might be divided as follows:—

(*a*) examination of individual witnesses, with, as convenient,
(*b*) visits to typical works or industrial centres, followed by
(*c*) a general conference between the Commission and the representative Provincial Committee.

9. The Commission will devote from a fortnight to three weeks to each of the larger provinces, and it will be an advantage to obtain from each Local Government, before the end of September, a programme indicating the most suitable centres for taking evidence and the most suitable places for visits to representative industries. It will be necessary to obtain, about the same time, a list of the individual witnesses nominated, in order that they may be supplied, about the middle of October, with a series of questions for the preparation of their preliminary written statements. It may be possible, in some cases, however, to nominate after this date additional witnesses on special subjects, but the Provincial Committees will doubtless take care that, in giving such advice, the programme in each case is not overloaded.

III.—DEVELOPMENT OF OFFICIAL ADMINISTRATION.

10. Under this heading arise problems connected with the establishment or development of Imperial and Provincial Departments which are concerned, in one way or another, with

industrial enterprise. In some provinces, there are already at work Directors of Industries, assisted by technical experts and in some cases, advised by Boards of Industries, while in other provinces, proposals for a similar organisation are under consideration. It is obvious that, to effect improvements in the unorganised or cottage industries, such as hand-loom weaving, and in any industry in which local circumstances completely supersede technical considerations, the establishment of provincial departments is likely to be advantageous; but for some of the larger industries, in which purely technical matters are paramount, it may be advisable to form Imperial Departments.

11. It has been suggested that such central organisations might be formed for some of the following :—

(*a*) chemistry, including agricultural, metallurgical, tinctorial, and pharmaceutical chemistry;

(*b*) the leather and hide industries;

(*c*) glass-making;

(*d*) sugar and alcohol manufactures;

(*e*) paper-making; and

(*f*) oil-seed industries.

12. Opinions might be obtained as to whether any Imperial Departments of this description should be constituted, and, if so, for what subjects. The nature of their administration should also be considered, that is, whether their heads should be purely advisory, with inspecting powers, as in the Forest Department, or should have administrative and executive control as in the smaller and more specialised Geological Survey Department.

13. It will be important also to obtain evidence as to the organisation of Provincial Industrial Departments, and the advisability of instituting Provincial Boards of Industries, or Advisory Committees, to include non-official members. Evidence as to the constitution and functions of these Boards or Committees should be obtained.

14. Finally, it will be necessary to obtain opinions regarding the relationship of a Provincial Industries Department with an Imperial Department of the kind mentioned in paragraph 11.

15. Evidence might also be obtained on the following points :—

(*a*) the suitability of the present system of collecting and distributing statistics and commercial intelligence, by the Director of Statistics and the Director-General of Commercial Intelligence, respectively;

(*b*) the advantages of establishing or assisting special journals for the chief industries and also general industrial and trade journals;

(*c*) any recognisable advantages which have followed the issue of special monographs and other Government publications such as those of the Forest and Geological Departments;

(*d*) the formation of commercial museums, and of sales agencies or of commercial emporia, in the principal towns of India and possibly abroad, for the display and the sale of the products of unorganised cottage industries;

(*e*) the institution of periodical industrial exhibitions;

(*f*) the appointment of trade representatives in other provinces, and, for the whole of India, in Great Britain, the Colonies and foreign countries;

(*g*) the possibility of establishing some system of Government certificates regarding the quality of products, accompanied by the institution of testing laboratories;

(*h*) the regulations of trade marks and the working of the patent laws; and

(*i*) the suitability of the present law for the acquisition of land on behalf of industrial companies.

IV.—GOVERNMENT AID TO INDUSTRIES.

16. Evidence might suitably be collected regarding the experience so far obtained of financial and technical assistance rendered to industrial enterprises, and opinions might be obtained as to the most suitable form in which Government aid can be given to existing or to new industries.

17. The following methods have been suggested, and some have been tried, at different times :—

(*a*) loans and money grants-in-aid;

(*b*) supply of machinery and plant by Government on the hire-purchase system;

(*c*) guaranteed dividends for a limited period, with or without subsequent refund to Government of the expenditure incurred in paying dividends at the guaranteed rate;

(*d*) guaranteed Government purchase of products for limited periods;

(*e*) concessions of land;

(*f*) special railway transport facilities and rates;

(g) bounties and subsidies;

(h) pioneering industries and handing them over to private companies;

(i) loan of services of Government-employed experts.

18. With regard to any of these forms of direct Government assistance, it will be important to obtain opinions as to whether, and to what extent, they should be accompanied by Government control, as for instance, by the appointment of Government Directors for the period during which the direct assistance lasts. The information collected by officers placed on special duty will assist the Provincial Committees and the Commission in considering the extent to which Government aids to new enterprises will compete with those already existing and with established external trades.

V.—TECHNICAL AND SCIENTIFIC WORK.

19. (a) What can be done to improve the labourers' efficiency and skill, generally or in particular industries? What advantages have followed from the establishment of industrial schools? What experience has been gained in training apprentices in factories or workshops?

(b) What steps are desirable for the improvement of supervisors of all grades and of skilled managers? Should assistance be given to these, or to technical experts of private firms, or to Government officials, to study conditions and methods in other countries? It is important to obtain some idea as to the benefits that have been gained by the deputation of officers abroad for special enquiries, or on ordinary study leave.

(c) What noticeable benefits have local industries received from researches conducted by Government Departments?

(d) What experience has been gained from demonstration factories? It would be interesting to obtain opinions as to where, and what kind of, factories should be instituted in each province.

(e) Problems have been referred at times to the Scientific and Technical Department of the Imperial Institute; it is important to obtain from those who have utilised the Institute opinions as to the relative merits of conducting researches in India and in England.

(f) It is understood that the activities of the new Advisory Council for Research in the United Kingdom may extend to India and Colonies; it will be useful to have opinions from scientific and technical men as to ways in which this opportunity may be utilised.

(g) It is important to obtain opinions as to the most suitable way of developing technological research institutions, such as the Indian Institute of Science. Should these be general in their interests or be confined to limited groups of related subjects, and should they be imperial in their interests, or be maintained as provincial institutions?

(h) Whether the time has come when measures should be adopted to prevent the unnecessary overlapping of research activities by Technical Departments, special Technological Institutes, and University Colleges?

VI.—MISCELLANEOUS QUESTIONS.

20. Evidence might be obtained regarding the following questions:—

(a) Facilities for the development of hydro-electric power and the positions of apparently suitable power sites in the various Provinces.

(b) The effect of railway freight rates on local industries. Are there any practicable changes that can be made with apparent advantage, or are there any railway extensions that are necessary to develope possible new industries, or to extend existing industries? What waterways can be improved with advantage?

(c) Have any local difficulties been noticed in the working of the new mining and prospecting rules issued in September 1913? Are there any minerals that are essential for industries of imperial importance that ought to be developed at public expense, for example, minerals of direct importance for the manufacture of munitions of war, or substances which are ordinarily obtained in commerce only from one country?

(d) Can the forest policy be modified so as to permit of reducing the cost of assembling raw forest products, as for example, by the concentration of special kinds of trees in limited areas, and by improved forest transport facilities?

(e) In view of the report of Sir Edward Maclagan's Committee, it is important to obtain opinions as to what extent, and in connection with what industries, co-operative societies can be encouraged.

(f) In connection with the points already noticed in paragraph 15, regarding the collection and distribution of information under Government agency, could the principal Government departments which use imported articles assist Indian industries by publishing lists of these articles, or by exhibiting the articles in commercial museums?

(g) The possibility of formulating a scheme for financing, by existing or new banking agencies, the marketing of indigenous products.

APPENDIX A—3.

INSTRUCTIONS TO PERSONS INVITED TO GIVE EVIDENCE BEFORE THE COMMISSION.

IT IS NOT INTENDED THAT INDIVIDUALS OR BODIES INVITED TO GIVE EVIDENCE SHOULD ATTEMPT TO ANSWER ALL THE QUESTIONS.

The Commission will naturally attach importance to the practical experience and special knowledge which witnesses have acquired of the matters regarding which they offer opinions.

1. The questions in the accompanying lists have been framed so as to cover, as far as practicable, the whole scope of the enquiry to be made by the Indian Industrial Commission.

2. Each witness will also be examined orally by the Commission. At the oral examination, he will probably be examined on his written evidence in order to make clear doubtful points, and otherwise to enable the Commission to estimate its value.

3. A Chamber of Commerce or similar body invited, as a Chamber or body, to give evidence, may either submit one set of answers to the questions, which it desires to answer, and select not more than three representatives to support its views in oral examination ; or it may nominate two or three individuals to give each his own views, in writing and afterwards orally. These individuals may be selected either as representing different interests or as having knowledge and experience of different subjects, or as representing different views on one or more subjects.

Individuals who are members of Chambers of Commerce or similar bodies may give evidence, at their own request or by invitation, independently of these arrangements. The evidence of these witnesses will be taken as representing their individual views only.

4. In answering the printed list of questions, *witnesses need not restrict themselves to a series of answers to the questions* on which they desire to give evidence. The questions are intended merely as a guide to show witnesses the matters on which the Commission desires to gather information and opinions. *The Commission prefers that witnesses should submit their views in a connected statement for each subject,* and include in each such statement their answers to the various questions.

5. Witnesses who desire that any portions of their evidence should be treated as confidential are requested clearly to mark such portions. Oral evidence will also be treated as confidential when witnesses so desire. They will be given the opportunity of revising the proofs of their oral evidence.

QUESTIONS FOR THE ASSISTANCE OF WITNESSES.

I.—FINANCIAL AID TO INDUSTRIAL ENTERPRISES.

Capital.

1. Please state if you have had any experience of the raising of capital for industrial enterprises ?

If so, what difficulties have you found in doing so ?

What suggestions have you to make for removing these difficulties ?

2. What are the sources from which capital for industrial enterprises is principally drawn ?

2 (*a*). Can you suggest any new sources from which capital may be drawn ?

3. Do you know of any kinds of industrial enterprises where more concerns have been started than can be maintained in full-time employment ?

If so, please describe the general conditions.

Government assistance.

4. What is your knowledge or experience of financial aid by Government to industrial enterprises ?

5. What are your opinions on the following methods of giving Government aid to existing or new industries :—

(1) money grants-in-aid ;
(2) bounties and subsidies ;
(3) guaranteed dividends for a limited period, with or without subsequent refund to Government of the expenditure incurred in paying dividends at the guaranteed rate ;
(4) loans, with or without interest ;
(5) supply of machinery and plant on the hire-purchase system ;

(6) provision of part of share capital of companies on the same basis as public subscriptions of capital;

(7) guaranteed or preferential Government purchase of products for limited periods; and

(8) exemption for a limited period of the profits of new undertakings from income-tax; and exemption from any tax on an industry, or on any article used in an industry.

6. In which methods of Government assistance should there be Government control or supervision?

What should be the form of such control or supervision? (*E.g.*, Government audit or appointment of Government directors with defined powers for the period during which direct assistance lasts.)

Pioneer factories.

7. What is your experience or opinion of Government pioneer factories?

[NOTE.—By pioneer factories are meant those established primarily to ascertain whether a new industry is commercially practicable?

By demonstration factories (see questions 19 and 20) are meant those established primarily for giving demonstrations of, and instruction in, improved methods for industries which have been proved to be commercially practicable.]

8. In what ways and to what extent should Government pioneer industries?

At what stage should pioneer factories be either closed or handed over to private capitalists or companies?

What limits and restrictions, if any, should be imposed on the conversion of successful pioneering experiments into permanent Government enterprises?

Financing agencies.

9. In your experience what industries are hampered by the conditions under which they are financed as going concerns?

Please describe the method of financing and its effect on the industry in each case.

10. In what ways is it possible to give more assistance to industrial undertakings by existing or new banking agencies?

10 (*a*). Do you think there is need of a banking law?

[See also question 39.]

Co-operative societies.

11. Do you know of any industries which have been developed or assisted by the formation of co-operative societies?

What were the exact means adopted and what were the results obtained?

12. In your experience what are the industries for which co-operative societies should be encouraged.

What should be the organisation and special objects of these societies?

12 (*a*). What suggestions have you to make for industrial development by means of Trade Guilds, such as exist in other countries?

How far should the State encourage the promotion of such Guilds?

Limits of Government assistance.

13. What principles should be followed in order to prevent Government aid competing with existing or discouraging fresh, private enterprises.

14. Should there be any limitations on Government aid to a new enterprise if it competes with an established external trade?

II.—TECHNICAL AID TO INDUSTRIES.

Technical aid in general.

15. What is your personal knowledge or experience of technical and scientific aid provided by Government to industrial enterprise?

16. What is your personal knowledge or experience of noticeable benefits received by local industries from researches conducted by Government departments?

17. On what conditions should the loan of Government experts be made to private firms or companies?

18. Under what restrictions and conditions would you allow publication of the results of researches made by a Government-paid expert while attached to a private business?

Demonstration factories.

19. Can you suggest any industry for which Government demonstration factories should be adopted and on what lines? (See note below question 7.)

20. Should any demonstration factories be instituted in your province?

Research abroad.

21. What has been your experience of the aid afforded by the Scientific and Technical Department of the Imperial Institute?

What are its advantages and disadvantages?

22. In addition to arrangements made for research in India, is it advantageous to have provision for research for special subjects in the United Kingdom?

If so, for what special purposes is it advantageous to conduct researches in England rather than in India?

23. In what ways can the Advisory Council for Research in the United Kingdom give assistance to Indian industries?

24. Can you suggest for this country any system, similar to that of the Advisory Council for Research in the United Kingdom, for referring research problems to Colleges and other appropriate institutions in India? (See questions 75 and 76.)

Surveys for industrial purposes.

25. Does the existing knowledge of the available resources of the country—agricultural. forest, mineral, etc.—require to be supplemented by further surveys?

26. How should such a survey be organised?

What should be its precise objects?

27. How should its results be made most useful to industries?

27 (*a.*) What is your experience or opinion of the value of Consulting Engineers appointed by Government to aid industrial enterprise by technical advice and by the supply of plans and estimates?

(*b*) Should such Consulting Engineers be allowed to undertake the purchase of machinery and plant for private firms or individuals? If so, under what conditions?

[See questions 63 *et seq.*]

III.—ASSISTANCE IN MARKETING PRODUCTS.

Commercial museums.

28. What is your experience or opinion of commercial museums, *e.g.*, that in Calcutta?

29. If you think commercial museums should be developed and increased in number what suggestions have you to make regarding their situation, arrangement and working.

Sales agencies.

30. What is your experience or opinion of sales agencies or commercial emporia for the sale as well as the display of the products of minor and unorganised cottage industries.

How should they be developed?

Exhibitions.

30 (*a*). Would travelling exhibitions of such industries be of advantage?

31. What is your opinion or experience of the value of industrial exhibitions?

32. Should Government take measures to hold or to encourage such exhibitions?

If so, what should be the Government policy?

33. What should be the nature of such exhibitions?

Should they be popular in character, or should they aim merely at bringing sellers and buyers into contact?

Trade representatives.

34. Should trade representatives be appointed to represent the whole of India, in Great Britain, the Colonies and foreign countries?

What should be the qualifications of these trade representatives?

How should their duties be defined?

35. In addition to these trade representatives would it be suitable in some cases also to have temporary Commissions for special enquiries?

36. Should provinces in India itself have trade representatives in other provinces?

How should such representation be arranged for?

Government patronage.

37. Should the principal Government departments which use imported articles publish lists of these articles, or exhibit them in commercial museums?

38. With reference to the encouragement of Indian industries, have you any criticisms to offer regarding the working of the present rules relating to the purchase of stores by Government departments?

Have you any changes to propose in the rules themselves.

Banking facilities.

39. In what way is it possible to assist in marketing indigenous products by more banking facilities, either through existing agencies (such as the Presidency, Exchange, Joint Stock and Co-operative Credit Banks) or through new agencies (such as Industrial and Hypothec Banks)? (See also question 10.)

IV.—OTHER FORMS OF GOVERNMENT AID TO INDUSTRIES.

Supply of raw materials.

40. What conditions should control the supply of Government-owned raw materials (*e.g.*, forest products) on favourable terms?

Land policy.

41. Is there any check at present imposed on industrial development in your province by the land policy of Government?

If so, what remedies do you suggest?

(NOTE.—The expression "land policy" is intended to cover laws and regulations relating to settlements, the Government assessment, rents, tenant rights, permission to use land for industrial purposes, and generally all matters connected with the ownership and use of land.)

42. On what principles should Government give concessions of land for the establishment of new, or the development of existing industries?

43. What criticisms have you to make regarding the working of the present law for the acquisition of land on behalf of industrial companies?

What modifications of the law do you recommend?

43(*a*). In what ways and on what terms can Government assist in the provision of subterranean or surplus surface water for industrial purposes.

V.—TRAINING OF LABOUR AND SUPERVISION.

General.

44(*a*). Do you think that the lack of primary education hinders industrial development?

(*b*) What has been done in any industry of which you have had experience to improve the labourers' efficiency and skill?

45. What steps do you consider should be adopted to improve the labourers' efficiency and skill—

(*a*) generally, and

(*b*) in any industry of which you have had experience?

Apprenticeship system and industrial and other schools.

46. What special knowledge or experience have you of the training of apprentices in factories and workshops?

47. What advantages have you observed to follow from the establishment of industrial schools?

48. On what lines should these two systems of training (*i.e.*, apprenticeship system and industrial schools) be developed and co-ordinated?

49. What has been your experience of day schools for short-time employees, or of night schools?

How should these be developed?

50. Should industrial and technical schools and commercial colleges be under the control of the Department of Education or of a Department of Industries?

What measures should be adopted in order that these two departments should work in unison in controlling industrial schools?

Training of supervising and technical staff.

51. What measures are necessary for the training and improvement of supervisors of all grades and of skilled managers?

52. What assistance should be given to supervisors, managers and technical experts of private firms to study conditions and methods in other countries? (See question 77.)

53. In what circumstances, and under what conditions should industries assisted by Government be required to train technical experts?

Mechanical engineers.

54. Is there a want of uniformity in the standard of examinations for mechanical engineers held in the various provinces where engineers in charge of prime-movers are required in certain cases to be certificated?

If so, should measures be adopted to make such tests uniform so that the Local Governments and Administrations may reciprocate by recognising each other's certificates?

55. If the law in your province does not require any qualifications in an engineer in charge of a prime-mover, have you any criticisms or suggestions to make?

VI.—GENERAL OFFICIAL ADMINISTRATION AND ORGANISATION.

56. What provincial organisation exists in your province for the development of industries?

What criticism have you to make regarding its constitution and functions?

57. What organisations do you recommend for the future development of industries in your province?

Should there be a Board of Industries?

If so, what should be the functions of such a Board?

Should it be merely advisory or should it have executive powers with budgetted funds?

58. If you recommend an Advisory Board, how should it be constituted?

59. If you recommend a Board with powers, what should be its constitution and how should its powers be defined?

60. Should there be a Director of Industries?

What should be his functions?

Should he be a business man, or a non-expert official, or a technical specialist?

What other qualifications should he possess?

61. If you recommend both the formation of a Board of Industries and the appointment of a Director of Industries, what should be the relations between the Board of Industries, the Director of Industries and the Provincial Government or Administration?

62. What form of machinery do you propose in order to correlate the separate activities of the various provinces as regards industries?

Is it practicable to form an Imperial department under a single head?

If so, what should be the functions of such a department?

Cottage industries.

62(*a*). Should there be special measures taken or special sections of a Department of Industries organised for the assistance of cottage industries?

62(*b*). Please explain in detail what should be the Government policy as regards cottage industries and how it should be carried into effect? In this connection, see especially questions 11, 30, 64 and 72.

62(*c*). What cottage industries do you recommend should be encouraged in this way?

VII.—ORGANISATION OF TECHNICAL AND SCIENTIFIC DEPARTMENTS OF GOVERNMENT.

General.

63. Are there in your province any technical and scientific departments which are capable of giving assistance to industries?

If so, what criticisms have you to make regarding their organisation?

What changes do you recommend?

Imperial department.

64. In order to aid industrial development do you recommend the formation of any new Imperial Scientific and Technical Departments?

If so, for what subjects or natural groups of subjects?

65. How should such an Imperial department be constituted and recruited?

66. What should be the powers of the head of the department?

If he has executive control of the department, what should be his relationship to the Imperial Government?

67. What should be the relationship of an expert, whose services are loaned by the Imperial department to a Local Government, with the Local Government and the latter's Department of Industries?

Provincial departments.

68. For what subjects should Local Governments engage their own experts or organise their own technical and scientific departments?

69. Under what direct control should these experts and departments be placed?

70. On what terms should these experts be employed?

Technological institutions.

71. What is the most suitable way of developing technological research institutions, such as the Indian Institute of Science?

71(*a*). Should there be a Technological Institute for each province, and should such Institutes be allowed to develop as independent units, or should they be fitted into a general development scheme for the whole of India, with a central Research Institute?

72. As regards investigation and research should each Institute be general in its activities and interests, or should each deal with limited group of related subjects?

73. Should there be any Government control?

If so, should this control be imperial or should it be purely provincial or local?

Co-ordination of research.

74. Is it desirable that measures should be taken to co-ordinate and prevent unnecessary overlapping of the research activities in Government Technical and Scientific Departments, special Technological Institutes and University Colleges?

If so, what are your suggestions?

75. What noticeable results have followed from the institution of the Indian Science Congress?

76. Can you suggest any ways in which the Congress might become more useful in assisting industrial development? (See question 24.)

Study of foreign methods.

77. What encouragement should be given to Government technical and scientific experts to study conditions and methods in other countries? (See question 52.)

Reference libraries.

78. What difficulties have you experienced in consulting technical and scientific works of reference?

79. Have you any suggestions to make regarding the establishment of libraries of such works?

Colleges of Commerce.

80. Do you think that the establishment of a College of Commerce is necessary in your province?

If so, on what lines should it be organised?

81. In what ways do you expect such a college to assist industrial development?

81(*a*). In what ways can Municipalities and Local Boards assist in promoting industrial and commercial development?

VIII.—GOVERNMENT ORGANISATION FOR THE COLLECTION AND DISTRIBUTION OF COMMERCIAL INTELLIGENCE.

Statistics.

82. Have you any criticisms to offer on the present system of collecting and distributing statistics by the Director of Statistics?

What changes do you suggest?

Commercial intelligence.

83. Have you any criticism to offer on the present system of collecting and distributing commercial intelligence by the Director-General of Commercial Intelligence?

What modifications do you suggest?

Industrial and trade journals.

84. What advantages have you found in the issue of the "Indian Trade Journal"?

85. Should Government establish or assist industrial or trade journals, either for general or special industries, which would be of real use to persons actively engaged in industries?

86. What proposals do you make for the dissemination of information of this kind through the various vernaculars?

Other publications.

87. What advantages have you known to follow the issue of special monographs on industrial subjects or publications like those of the Forest and Geological Departments?

What measures do you advise in order to increase the usefulness of these publications?

88. Are there any other directions in which Government could collect and publish information of a kind likely to assist industries and trades?

IX.—Other forms of Government action and organisation.

Certificates of quality.

89. Are there any products for which a system of Government certificates of quality should be established?

For what products should such certificates be compulsory, and for what products voluntary?

90. What should be the organisation for testing each class of products and granting certificates?

Prevention of adulteration.

91. Are there any classes of materials for manufacture or of manufactured articles for the adulteration of which penalties should be imposed.

92. For each such class of goods what organisation do you suggest for purposes of inspection and prosecution of offenders?

Misdescription.

93. Have you any other suggestions to make in regard to the prevention of misdescription of goods generally?

Trade marks and trade names.

94. What is your opinion on the present state of Indian law relating to marks and descriptions of proprietary and other articles of trade.

Patent laws.

95. Have you any criticisms or suggestions to make regarding the existing law and regulations relating to patents?

Registration of partnerships.

96. Is it desirable and practicable in the interests of trade, to introduce a system of registration or disclosure of partnerships?

Roads, railways and waterways.

97. To what extent does the lack of transport facilities by road, rail or water hinder industrial development in your province?

Have you any specific recommendations to make?

98. Have you any criticisms to offer regarding railway freights, the classification of goods, the apportionment of risk, and the regulation of rates?

What are your proposals?

99. Are there any railway extensions necessary in your province to develope new or to extend existing industries?

100. Similarly, are there any waterways which should be constructed, extended or improved?

Shipping freights.

101. Are you aware whether the external trade or internal industries of the country are handicapped by any difficulties or disadvantages as regards shipping freights?

Can you suggest any remedies?

Hydro-electric power surveys.

102. What has been done in your province towards ascertaining the possibilities of developing hydro-electric power?

Should further investigation be made in this matter?

102 (*a*). Have you any criticisms to make regarding the effect of the Electricity Act on industrial enterprise?

Mining and Prospecting Rules.

103. What difficulties have been experienced in the working of the Mining and Prospecting Rules (1913)?

104. Are there any minerals that are essential for industries of Imperial importance that ought to be developed at public expense? (*E.g.*, minerals of direct importance for the manufacture of munitions of war, or minerals ordinarily obtained in commerce from one country only.)

Forest Department.

105. From the point of view of industrial enterprise, have you any criticisms to make regarding the policy and working of the Forest Department?

What suggestions do you make?

106. What measures are practicable to reduce the cost of assembling raw forest products?

107. To what extent is it practicable to concentrate special kinds of trees in limited areas?

108. What noticeable deficiencies in forest transport are known to you?

What suggestions do you make for their removal?

Jail competition. 109. Have you any complaints to make regarding competition by jail industries?

X.—GENERAL.

110. What suggestions have you to make for the development of any industry in which you have been actively concerned or interested?

111. Does your experience suggest to you any new industry for which India seems peculiarly suited on account of its resources in raw materials, labour and market?

112. What supplies of raw materials are known to you of which the use in industry or trade is retarded by preventible causes?

What are these causes, and how should they be removed?

112 (*a*). Have you any suggestions to make regarding the utilization of waste from raw materials?

112 (*b*). Have you any suggestions to make regarding Government aid in the improvement of raw material, such as, cotton, silk, sugarcane, etc.?

112 (*c*). What industries in the country are dependent on the importation of raw materials and partly manufactured articles from abroad?

113. Do you know of any supplies of raw materials for which there is a good case for investigation with a view to their development?

APPENDIX—A-4.

ITINERARY OF THE PRESIDENT'S MONSOON TOUR 1916.

1916—

June 30th . . .	Departed	Simla.
July 2nd to 13th . .	Halted	Calcutta.
„ 14th to 16th . .	„	Ranchi.
„ 17th to 19th . .	„	Sakchi.
„ 20th and 21st . .	„	Calcutta.
„ 22nd to 24th . .	„	Kulti with a visit to Asansol.
„ 25th and 26th . .	„	Calcutta.
„ 28th to August 4th .	„	Madras with visits to Nellikuppam and Cuddalore.
August 5th and 6th . .	„	Coimbatore.
„ 7th and 8th . .	„	Ootacamund.
„ 9th to 15th .	„	Bangalore with a visit to Oorgaum.
„ 17th to 24th .	„	Bombay.
„ 25th to September 3rd	„	Nagpur.
September 4th to 8th .	„	Jubbulpore with a visit to Katni.
„ 9th	„	Maihar.
„ 10th	„	Allahabad.
„ 11th to 15th .	„	Naini Tal.
„ 16th to 17th .	„	Dehra Dun.
„ 18th to 20th .	„	Cawnpore.
„ 21st . . .	Returned	Simla.

ITINERARY FOR THE YEAR 1916-17 (FIRST TOUR OF COMMISSION).

1916—		
October 27th . . .	Assembled at Delhi .	Mr. Low was absent October 27th—November 16th.
„ 27th to November 1st.	Halted Delhi.	
November 2nd . . .	„ Dehra Dun.	
„ 3rd . . .	„ Bareilly.	
„ 4th and 5th .	„ Lucknow .	Pandit Malaviya was absent November 5th—7th.
„ 6th to 12th .	„ Cawnpore .	Pandit Malaviya was absent November 12th—17th. Sir D. Tata was absent November 10th—30th.
„ 13th . . .	„ Agra. .	Sir F. Currimbhoy was absent November 13th—26th.
„ 14th . . .	„ Firozabad.	
„ 15th . . .	„ Benares.	
„ 16th to 20th .	„ Bankipore.	
„ 21st to 26th .	„ Muzaffarpur with a visit to Pusa.	
„ 27th to December 13th.	„ Calcutta.	
December 14th to 20th .	„ Nagpur with a visit to Katni.	Sir F. Currimbhoy was absent December 17th—24th. Pandit Malaviya was absent December 17th—24th. Sir F. Stewart was absent December 14th—23rd. Sir D. Tata was absent December 17th—24th.
„ 21st to 23rd .	„ Jubbulpore.	
„ 24th to January 5th, 1917.	„ Calcutta.	
1917—		
January 6th . . .	„ Kulti .	Sir F. Stewart was absent January 6th—8th.
„ 7th and 8th . .	„ Sakchi.	
„ 9th to 19th . .	„ Calcutta .	Sir D. Tata was absent January 19th—28th.
„ 21st to 31st . .	„ Madras .	Sir T. Holland was absent January 29th—February 14th.
February 1st to 3rd . .	„ Calicut .	Dr. Hopkinson was absent February 1st—3rd.
4th to 8th . .	„ Coimbatore .	Pandit Malaviya was absent February 4th—14th.
9th to 14th .	„ Bangalore.	
17th to 20th .	„ Delhi.	

Subsequently went into recess.

ITINERARY FOR THE YEAR 1917-18 (SECOND TOUR OF COMMISSION).

1917—

November	7th	Assembled at Bombay.	
„	7th to December 4th.	Halted Bombay	Sir T. Holland was absent December 2nd—24th. Mr. Chatterton was absent November 28th—December 24th. Pandit Malaviya was absent November 7th—December 10th. Sir R. Mookerjee was absent December 1st—9th.
December	6th to 15th	„ Lahore.	
„	16th and 17th	„ Lyallpur with a visit to Gojra.	
„	18th and 19th	„ Rasul	Pandit Malaviya was absent December 18th—22nd.
„	20th to 22nd	„ Amritsar with a visit to Dhariwal.	
„	24th to January 3rd, 1918.	„ Calcutta	Sir T. Holland, Sir F. Currimbhoy and Sir D. Tata were absent January 3rd.

1918—

January	4th to 8th	Halted Gauhati	Sir T. Holland, Sir F. Currimbhoy, and Pandit Malaviya did not take part in Assam or Burma tours. Sir D. Tata did not take part in Assam tour.
„	9th and 10th	„ Shillong.	
„	12th to 18th	„ Calcutta.	
„	21st „ 26th	„ Rangoon.	
„	28th and 29th	„ Namtu with a visit to the Bawdwin Mine.	Sir D. Tata was absent January 28th—29th.
„	31st to February 1st	„ Mandalay.	
February	2nd	„ Nyaungu.	
„	3rd	„ Singu.	
„	4th	„ Yenangyaung.	
„	5th	„ Allanmyo.	
„	6th	„ Prome.	
„	7th and 8th	„ Rangoon.	
February	12th to April 6th	Halted Calcutta	After February 14th the Commission went into recess. The Members met March 18th—29th to consider the draft report, with the exception of Sir T. Holland who was unable to be present. Mr. Chatterton was absent March 24th—29th and Pandit Malaviya March 18th—21st.
April	8th	Arrived Simla	

LIST OF INSPECTIONS (1916-17 TOUR).

Date of inspection.	*Name of place visited or inspected.*
October 1916—	
26th	Delhi Biscuit Factory.
28th	The Art Industries of Delhi.
November 1916—	
2nd	Forest Research Institute, Dehra Dun.
	Thymol Factory of the Dixon Chemical Company, Dehra Dun.
3rd	Match Factory, Bareilly.
	Furniture Workshops, Bareilly.
	Government Carpentry School, Bareilly.
4th	Upper India Paper Mills, Lucknow.
	School of Arts and Crafts, Lucknow.
	Mechanical Engineering School, Lucknow.
7th	Cawnpore Woollen Mills.
8th	Brushware, Limited, Cawnpore.
	Elgin Mills, Cawnpore.
9th	Messrs. Cooper Allen and Company, Limited, Cawnpore.
10th	Government Harness Factory, Cawnpore.
11th	Village Settlements, Cawnpore.
12th	Cawnpore Sugar Works, Limited.
13th	John's Flour Mills, Agra.
14th	Glass Works at Firozabad.
15th	Government Weaving School, Benares.
16th	Bihar School of Engineering, Bankipore.
22nd	Japaha Sugar Company, Muzaffarpur.
23rd	Agricultural Research Institute, Pusa.
24th	Bose's Cutlery Factory, Muzaffarpur.
	Bengal Preserving Company, Muzaffarpur.
25th	Saltpetre Refinery, Muzaffarpur.
29th	Titaghur Paper Mills.
	Titaghur Jute Mills.
30th	Calcutta Pottery Works.
December 1916—	
2nd	Sibpur Civil Engineering College.
4th	Calcutta Port.

LIST OF INSPECTIONS (1916-17 TOUR)—*contd.*

Date of inspection.	*Name of place visited or inspected.*
December 1916—concld.	
5th	Pen and Pencil Factory of Messrs. F. N. Gooptu and Company, Calcutta.
6th	Messrs. Jessop and Company's Iron Works, Howrah.
12th	Bengal National Tannery, Calcutta.
15th	School of Handicrafts, Nagpur.
20th	Cement Works, Katni.
21st	Pottery Works of Messrs. Burn and Company, Jubbulpore.
22nd	Gun Carriage Factory, Jubbulpore.
January 1917—	
6th	Bengal Iron and Steel Company's Works, Kulti.
	Kumardhubi Engineering Works, Limited (Bird and Company).
	Kumardhubi Fireclay and Silica Works, Barakar.
7th and 8th	Tata Iron and Steel Company, Sakchi.
12th	Workshops of Messrs. Burn and Company, Howrah.
13th	Messrs. D. Waldie and Company and the Bengal Distilleries, Limited, Konnagar.
	Government Central Weaving Institute, Serampore.
15th	Ordnance Factories, Cossipore and Ishapur.
23rd	Buckingham and Carnatic Mills, Madras.
25th	Chrome Leather Company's Tannery, Pallavaram.
26th	Indian Aluminium Company, Madras.
27th	Harbour Works, Madras.
February 1917—	
1st	Henke's Tile Works, Feroke, Malabar.
	Government Fish Canning Station, Beypore.
3rd	Cocoanut Oil Mill, Calicut.
	Coir Weaving Shed, Calicut.
	Basel Mission Weaving Establishment, Calicut.
	New Malabar Timber Yards, Calicut.
	Government Soap Factory, Calicut.
5th	Agricultural College, Coimbatore.
8th	Singanallur Jaggery Factory (near Coimbatore).
11th	Sandalwood Oil Factory, Bangalore.
12th	Kolar Gold Fields.
13th	Indian Institute of Science, Bangalore.
	Steam Jaggery Boiling Plant, Agaram.

LIST OF INSPECTIONS (1917-18 TOUR).

Date of inspection.	*Name of place visited or inspected.*
November 1917—	
14th	Bombay Harbour.
17th	Great Indian Peninsula Railway Carriage and Wagon Workshops, Matunga.
19th	J. J. School of Art, Bombay.
20th	Victoria Jubilee Technical Institute, Bombay.
21st	Bombay Medical Stores Depôt.
22nd	Inspection of Chawls, Bombay.
24th	Tata Hydro-electric Works.
27th	Royal Indian Marine Dockyard, Bombay.
28th	Sydenham College of Commerce, Bombay. Bombay Swadeshi Stores.
29th	Queen Mary Technical School for disabled Indian Soldiers, Bombay.
December 1917—	
9th	Government Rosin and Turpentine Factory, Jallo.
11th	North-Western Railway Workshops, Lahore. Railway Technical Institute, Lahore. Hindu Technical School, Lahore.
14th	Government Central Weavery, Lahore.
15th	Mayo School of Art, Lahore. Central Jail and Borstal Jail, Lahore.
16th	Cotton Market, Gojra.
17th	Agricultural College, Lyallpur. Wheat Elevator, Lyallpur.
18th	Salt Mines, Khewra.
19th	Engineering College, Rasul. Head Works of Lower Jhelum Canal. Upper Jhelum Canal.
20th	Hydro-electric Works and Pumping Scheme, Amritsar.
21st	Criminal Tribes Settlement, Dhariwal. New Egerton Woollen Mills, Dhariwal. Borstal Jail, Dhariwal.
22nd	Ghulam Sadiq's Carpet Factory, Amritsar. Municipal Technical School, Amritsar.

LIST OF INSPECTIONS (1917-18 TOUR)—*concld.*

Date of inspection.	*Name of place visited or inspected.*
January 1918—	
6th	Silk-Weaving Village of Sualkuchi.
10th	Experimental Fruit Station, Shillong.
22nd	Arts Exhibition, Rangoon.
23rd	Teak Yards and Saw Mills of the Bombay-Burma Trading Company, Limited, Rangoon.
24th	Messrs. Steel Brothers' Rice Mill at Pazundaung.
25th	Burma Oil Company's Refineries at Syriam.
28th	Namtu Smelters.
29th	Bawdwin Mine.
31st	Irrawaddy Match Company, Mandalay.
February 1918—	
1st	Saunders' Weaving Institute, Amarapura.
2nd	Lacquer Workers at Nyaungu.
3rd	Oil fields, Singu.
4th	Oil fields at Yenangyaung—Drilling and Pumping station.
5th	Jamal's Cotton and Produce Company, Limited, Allanmyo.
6th	Hand-loom Weaving at Shwedaung.
7th	Government School of Engineering and Technical High School, Insein.
28th	Calcutta Technical Evening School.
March 1918—	
11th	East Indian Railway Locomotive Workshops, Jamalpur.

APPENDIX B.

DRAFT NOTE ON THE INDUSTRIAL ASPECT OF COTTON GROWING IN INDIA.

The world position.

The first point for consideration is the possible increase of the outturn of Indian cotton. The figures below, which are taken from Professor Todd's book "The World's Cotton Crops" (pages 395, 410), will show the world position.

(Figures in 000's of 500 lbs bales.)

* Year.	1907-08.	1908-09.	1909-10.	1910-11.	1911-12.	1912-13.	1913-14.
Production .	18,640	22,271	20,536	22,829	26,186	26,044	27,703
Consumption .	21,053	22,387	22,318	24,605	26,126	26,863	27,000

According to these estimates, the supply was as a rule in considerable deficit, but it is, at any rate, clear that there has thus been an actual shortage of cotton, which will tend to become more acute as the standard of comfort rises in the less civilised countries of the world. It seems a generally accepted view that much more cotton cloth could be sold, if greater supplies of cotton were available. In case of shortage, it is evident that Great Britain will be the chief sufferer. Her mills consumed 4,300,000 bales, of which 3,700,000 (500 lbs.) came from America, 400,000 from Egypt (720 lbs.), 50,000 from India (400 lbs.), and 150,000 from elsewhere. The mill consumption of the United States of America has followed the course shown below :—

Year.	000 bales.	Proportion of United States crop consumed by United States mills.
1911	4,301	35·6
1912	5,391	33·5
1913	5,389	38·2
1914	5,503	37·8
1915	6,088	40·3

The increase in the average United States crop for the above period over the period 1890-96 was 6,000,000 bales, of which increased consumption in the United States took 2,730,000 bales, and Continental increased consumption 2,630,000 bales, leaving only 640,000 bales for Great Britain.

The last year shows the highest percentage of any year except 1910, when the United States mills took over 40 per cent. of the very small crop of the year. It seems clear that the relative proportion of the crop taken by the local mills is bound to increase, and that any such increase will be at the expense of British spinners.

The latter have carefully examined the developments possible in different parts of the British Empire.

In comparison with Britain's African Colonies, India is a country with good communications, an intelligent agricultural population, and large areas under cotton. For these reasons, it has been held that in no other country can the requisite increase of the cotton crop be obtained so quickly. The matter is too urgent, from the point of view of the textile trade of the world, and especially of Great Britain, to admit of awaiting the results of work in so

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NOTE.—The Commission understands that a preliminary version of the above note, prepared in December 1916, was placed before the Secretary of State by the Government of India, and was taken into consideration by him when sanctioning the appointment of the Cotton Committee. This body has been enquiring into the various matters raised in this note, and the Commission therefore thinks it unnecessary to revise the draft note, which, however, it desires to place on record.

* Statement No. I appended shows further details and values.

difficult a country as tropical Africa. Admitting the need, it is hardly part of our duty to enquire if a case can be made out for bringing any pressure, other than the inducement of higher profits, to bear on the Indian ryot, in order to get him to increase the area under cotton. Indeed, even an increased price for cotton will tend to fail of effect by enhancing the price of food grains, if it raises the proportionate area under cotton beyond a very easily reached limit. If, on the other hand, the outturn of the existing cotton area can be increased, then the inducement to grow cotton will be the greater, while the world, including India, will get what it wants, namely, more cotton. There is no doubt a great deal of scope for improvement. The average yield for India is 98 lbs. of ginned cotton per acre ; while the figures for America and Egypt are 200 lbs. and 450 lbs., respectively.

It is agreed by various authorities that the average annual cumulative increase in the world's demand will be somewhere between 1,000,000 and 750,000 bales. An increase of 50 per cent. in the outturn of 6,000,000 bales, which may be taken as representing the present possibilities of India's crop, would satisfy this demand for three years. An increased outturn is perhaps the least difficult of the various agricultural problems connected with Indian cotton. Granted a research department to produce more prolific types, an organisation to introduce them, and an increased supply of fertilisers ; and the rest is merely a question of time. The progress that has been made along these lines will be discussed when we come to speak of the work that is being done in the different provinces. But the matter is further complicated by the low money value of most of the Indian crop, the demand of Indian spinners for a longer staple, and the generally expressed doubts of European spinners to what extent any increase in the Indian short-staple will really relieve the situation, and whether India herself is not incurring grave risks by continuing to rely so largely on a single type of staple.

Increase of yield and improvement of quality.

2. We may first consider then what should be the place assigned to the rival or rather complementary policies of increasing the yield of the indigenous short-staple cotton, which has been the most important feature in the work of more than one province hitherto, and of introducing longer-staple varieties. From an imperial point of view, it is perhaps unsatisfactory, that India should export the bulk of her surplus cotton to foreign countries, while England depends for her materials on America, or has to make desperate efforts to supplement them by supplies from her younger colonies and dependencies. An unsatisfactory feature of India's large export to foreign countries has been illustrated during the war by the fact that the initial German stocks of cotton for explosives had their origin in India, and that no inconsiderable amount of Indian cotton is made up in foreign countries and re-exported to India as manufactured goods to compete with those of her own production. On the other hand, the short-staple over a very large area gives the biggest profit to the cultivator, and will apparently continue to do so for some time to come. We have, however, to consider whether India's present position is satisfactory from her own point of view in view of future possibilities.

Professor Todd (The World's Cotton Crops—pp. 383-384) believes that, with a reduced acreage during the war, the demand for cotton when the war is over will be difficult to meet, the European nations that have suffered most from the war will be apt to use cotton in substitution for the more expensive textiles that they required previously, while eastern nations, who mainly wear cotton cloth, have been less affected by the war, and will need at least a normally increased quantity of cotton cloth. There seems nothing in post-war conditions that is likely to lead to a falling-off in the demand for cotton. There is some reason to believe that the area sown with cotton in the United

States of America is not likely to increase very rapidly in future. The growers have been led by the war to see more than ever the advantages of a more mixed system of cropping. Labour is getting scarcer in the Southern States, and its wages have risen very strikingly; and the spread of the boll-weevil has shown no signs of slackening. It may be added that the increased wealth brought into the United States of America by the war will probably lead to the construction of more mills and the local consumption of more of its own cotton. These factors, while increasing the demand for cotton generally, will tend to enhance the existing premium on long-staple cotton very considerably. The premium on Egyptian over American cotton rose as between the period 1894-98 and 1909-13 from 1·12*d*. to 3·45*d*., per lb., or from 26 per cent. to 53 per cent.

Position of short-staple crop.

3. It is alleged by Professor Todd (p. 21) that many spinners, especially on the Continent of Europe, use rather longer-staple cotton than they really need to spin the counts which they produce. The more cotton that India can produce of a slightly better type, the more of the longer-staple that these mills at present use can be released for the use of spinners who really need it. If the above is correct, in view of the greatly increased competition for American cotton that the considerations adduced in the preceding paragraph indicate, the greater would be the advantage gained by this substitution. Sir Bezonji Dadabhoy, however, stated that no one uses any longer-staple than he needs at present. Before the war, India sold much of her short-staple cotton to European countries, and it is probable that this trade will revive, and even increase to some extent, as the replacement of wool by, or its admixture with, short-staple cotton is stimulated by invention, and by the desire to use a cheaper material than wool. On the other hand, the main direction of expansion of the cotton industry in India, as elsewhere, is sure to be towards the use of finer staples and higher counts, as the standard of comfort in the less civilised parts of the world rises.

Finally, as Japan is stimulating the growth of cotton, mostly of the American type, in Corea, so at no distant date circumstances may place her in a position to increase the cotton yield of China. The Chinese crop has hitherto been a very obscure factor, but is, it would seem, capable of indefinite expansion, with improved communications and a more settled system of Government. About 1¾ million bales are said to enter commercial channels, and much is consumed internally in addition. The yield was very recently stated by a member of the Japanese textile industry at 7,000,000 piculs, or 2⅓ million bales, the area having increased owing to the replacement of opium by cotton in the Shensi Province. The bulk of it is of the Indian type, and whatever may be done—and much no doubt will be done—to improve the length of staple, there will be for long a large quantity of short-staple cotton available. Whether the exploitation of Chinese cotton will, in such circumstances, ever constitute a serious menace to the price which the Indian grower of short-staple cotton in India can command cannot be foreseen, but the risk is worth bearing in mind.

The "Japan Chronicle" of 18th January 1917 stated that in 1904 Japan imported 17,550,000 kwan of Indian and 15,300,000 kwan of Chinese cotton. Owing to the neglect of cotton cultivation in China, Japan drew a relatively larger proportion of her supplies from India, but if the quality of Chinese cotton is further improved, it will be able to meet about 70 per cent. of Japan's demands.

The Indian crop and its consumption.

4. The statement below shows the final estimates of areas under cotton in India for the years since 1907-08, together with the production, deduced

from the total of exports, mill consumption and estimates of extra-mill consumption :—

Year.	Area in 000 acres.	Outturn in 000 bales of 400 lbs.
1907-08	21,630	3,782
1908-09	19,999	4,200
1909-10	20,545	4,928
1910-11	22,596	4,203
1911-12	21,615	3,985
1912-13	22,028	4,483
1913-14	25,023	5,913
1914-15	24,595	4,889
1915-16	17,746	5,109
1916-17	21,212	4,760

India's crop in 1913-14 was valued at 81 crores of rupees or £54 million sterling, which was 15 per cent. of the value of the world's total crop in that year.

The statement below shows the countries to which and the quantities in which Indian cotton was exported from 1911-12 to 1915-16.

Country to which exported.	1911-12	1912-13	1913-14	1914-15	1915-16
	Cwt.	Cwt.	Cwt.	Cwt.	Cwt.
United Kingdom	418,012	305,545	384,914	707,779	833,628
Germany	890,516	950,199	1,688,070	1,239,472	...
Belgium	774,463	864,304	1,133,083	794,369	...
France	291,960	327,767	524,264	552,273	205,457
Spain	127,815	86,950	166,933	224,964	239,025
Italy	680,271	583,698	848,576	1,354,902	1,124,106
Austria-Hungary	471,580	396,452	747,041	585,735	...
China (exclusive of Hong-Kong and Macao)	48,097	118,007	84,707	146,026	296,664
Japan	3,514,651	3,591,768	4,817,560	4,454,931	5,917,663
Other Foreign Countries	40,539	56,296	105,735	169,504	140,238
Total Foreign Countries	6,839,892	6,975,441	10,115,969	9,522,176	7,923,153
Total British Empire (excluding United Kingdom).	70,619	96,526	125,429	119,090	97,186
GRAND TOTAL	7,328,523	7,377,512	10,626,312	10,349,045	8,853,967

5. The following statement shows the estimated areas of the various classes of staple during the year 1916-17 :—

Description of cotton.	Acres.
Oomras—	
Khandesh (Bombay)	1,423,000
Central India	1,411,000
Barsi and Nagar (Bombay)	3,436,000
Berar	3,118,000
Central Provinces	1,283,000
Total	10,671,000
Dholleras (Bombay)	2,046,000
Bengal—Sind—	
United Provinces	1,184,000
Rajputana	415,000
Sind-Punjab	1,430,000
Others	73,000
Total	3,102,000
Broach (Bombay)	1,230,000
Kumpta-Dharwars (Bombay)	1,097,000
Westerns and Northerns (Madras)	1,382,000
Cocanadas (Madras)	289,000
Tinnevelly (Madras)	707,000
Salems including Cambodias (Madras)	337,000
Comillas, Burmas, and other sorts	351,000
GRAND TOTAL	21,212,000

6. The following descriptions of the leading types of Indian cotton have been selected from the table on page 81-2 of Mr. Pearse's latest report:—

Broach	Very white, good staple and silky ⅞″ to 1″.
Kumpta and Saw-ginned Dharwar. .	Dull, yellowish and silky ⅝″ to ⅞″.
Dhollera	½″ to ⅞″.
Oomra	½″ to ⅝″, except Hinghanghats, which are up to 1″.
Bengal	⅜″ to ½″.
Sind deshi	Like the last.
Tinnevelly (Karuṅganni) . . .	1″.
Cambodia	1″.

Westerns and Northerns ¾″ to 1″. Northerns are rather reddish, Westerns fairly white. Both grow in North Madras.

Cocanadas ⅝″, like Northerns, heavy yielder.

Further details can be found on pages 26-7 of Professor Todd's book.

Figures of prices for middling American and Indian cotton (No. 1 Oomras) and for exports of the latter go to show that when the difference rise, and especially if it exceeds or even approaches one penny, the exports of Indian cotton increase.

This fact also tends to support the view expressed above, that Indian cotton, especially if slightly improved, could replace some of the American cotton at present being consumed in the spinning of comparatively low counts.

Including as long-staple cottons those varieties that produce fibre of approximately 1″ in length, we have from the last forecast—Broach 1,230,000 acres, Tinnevelly 707,000, Salems 337,000—total 2,274,000 acres. Some deduction must be made from this, on account of shorter-staple cotton produced in the tracts which have been taken above as long-staple areas. On the other hand, some addition must be made for long-staple cotton, like introduced varieties and Hinghanghats, which have been included among Bengals and Central Provinces types, as not considerable enough at present for separate, enumeration. No details are as yet available for outturn of the long-staple varieties, but reckoning 3 acres to the bale, which is considerably in excess of the average Indian yield of 98 lbs., the total yield is something like 400,000 bales of 400 lbs. The yield has been variously estimated by experts at from 350,000 to 500,000 bales. A considerable quantity of this is said to have gone to Japan, though this is denied by others.

Mr. Couchman in his Handbook of Commercial Information for Madras (pages 37-44) attempts a percentage estimate of the destinations of the leading types of cotton exported from that Presidency.

Tinnevellies.		Cocanadas.		Total Madras cottons.	
Country.	per cent.	Country.	per cent.	Country.	per cent.
Japan	36	Belgium . . .	35	Japan . . .	36·3
United Kingdom . .	25	Germany and Austria-Hungary . .	14	Belgium . . .	19
				United Kingdom .	17
Germany . . .	6	France . . .	13	Germany . . .	47
Italy	3·6	Italy . . .	12	Italy . . .	5·4
Austria-Hungary . .	...	United Kingdom .	11	Austria-Hungary .	5·3
Belgium and China .	3	Japan . . .	9	France . . .	3·3

A consideration of the above table tends to support the view that Japan also requires longer-staple cotton.

7. The statement below shows the imports from abroad and the production by Indian mills of low, medium and high counts of yarn during the past five years:—

Statement comparing the imports of coarse, medium and fine yarns with the production of similar descriptions by the Indian mills.

Unit—1,000 lbs.		1910-11.		1911-12.		1912-13.		1913-14.		1914-15.		1915-16.	
			per cent.		per cent.		per cent.		per cent.		per cent.		per cent.
Nos. 1-25.	Imported	1,602	·3	1,549	·3	4,148	·7	2,150	·3	813	·2	1,338	·2
	Indian	553,948	99·7	565,199	99·7	623,834	99·3	616,688	99·7	590,829	99·8	660,688	99·8
	Total	555,550	87·2	566,748	85·4	627,982	85·8	618,838	86·0	591,642	86·0	662,026	87·6
Nos. 26-40.	Imported	19,674	26·8	28,322	32·5	31,395	34·0	27,343	30·3	28,842	33·0	25,613	30·2
	Indian	53,743	73·2	58,924	67·5	60,989	66·0	62,711	69·7	58,447	67·0	59,123	69·8
	Total	73,417	11·5	87,246	13·2	92,384	12·6	90,054	12·5	87·289	12·7	84,736	11·2
Above 40.	Imported	6,627	78·3	7,131	76·4	8,763	74·9	7,858	74·4	7,021	75·9	7,512	79·3
	Indian	1,840	21·7	2,199	23·6	2,938	25·1	2,698	25·6	2,233	24·1	1,963	20·7
	Total	8,467	1·3	9,330	1·4	11,706	1·6	10,556	1·5	9,254	1·3	9,475	1·2
	GRAND TOTAL	637,434	100	663,324	100	732,072	100	719,448	100	688,185	100	756,237	100

There is very little European trade under the lowest counts for Indian mills to supplant; on the other hand, Japanese competition has recently become severe in respect of some of these descriptions. The greatest scope for the expansion of the Indian industry appears to exist under the medium and higher counts. To produce a staple suitable for counts above 40's, India would have to grow either a much higher grade American cotton than has been hitherto attempted on anything like a commercial scale, or an Egyptian cotton. The latter can certainly be grown in Sind, and perhaps in the Punjab and in Rajputana. It is stated that in the case of both the first and the last, irrigation would be needed on a far more ample scale than at present. Further enquiries will have to be made regarding the areas that can be made available for the higher classes of staple. For the present the figure for the Punjab and Sind may be provisionally placed at 3,500,000 acres. We have seen what looks like a much lower estimate, *viz.*, 350,000 acres in the Punjab within the next four years. The present area under American cotton in that province is 120,000 acres. Mr. Hailey (*vide* paragraph 8) puts the area available for American or other cotton requiring early irrigation at 500,000 acres. No information has yet been obtained for Bombay or Madras. The Central Provinces are not likely to be able to afford more than 100,000 acres for irrigated cotton.

With regard to the improvement of the indigenous staple, there is no doubt that any improvement in length, etc., while maintaining the hardiness, ginning percentage and outturn of the present type, would be a very great help. If the present cottons from which 10's are now spun could be improved so as to yield 15's or even 20's, the future of the Indian crop would be far more secure than it at present appears.

Work by Agricultural Department.

8. Having discussed the necessity for and the probable effects of:—

(*a*) an increase in the production of short-staple cotton

(*b*) the introduction of more long-staple cotton;

we may now examine the efforts which are being made in the chief cotton-growing provinces of India towards these ends. The statement in paragraph 5 above shows the areas under the main types of cotton in the different provinces. This is far from a complete classification by types and areas, but is a compromise between what is ideal and what is possible.

Speaking very generally, the present facts and future possibilities in the different provinces are exhibited in the statement below, and in the description which follows it of the position in the chief cotton-growing provinces.

The statement below indicates the area under cotton in each of the leading cotton-growing provinces of British India during each year since 1907-08 and the yield in bales. A reference to the table in paragraph 5 will show to some extent the types of cotton grown in each case.

Area in 000's of acres.
Yield in 000's of bales of 400 lbs.
Value in 000's of rupees.

Year.	...	Bombay and Native States.	Central Provinces and Berar.	Madras and Native States.	United Provinces.	Punjab and Native States.
1907-08	Area	7,101	4,432	1,855	1,461	1,474
	Yield	1,039	595	198	268	356
	Value	9,80,39	5,26,95	1,93,70	2,12,52	2,76,88
1908-09	Area	6,241	4,176	1,576	1,392	1,562
	Yield	1,282	766	162	426	324
	Value	14,23,62	7,08,07	1,46,96	3,41,69	2,89,17
1909-10	Area	6,469	4,167	1,569	1,241	1,436
	Yield	1,661	1,070	180	384	396
	Value	19,42,50	10,96,92	1,79,92	3,50,98	3,52,01
1910-11	Area	7,334	4,487	1,873	1,347	1,385
	Yield	1,450	629	235	348	306
	Value	20,25,02	8,06,92	2,82,02	4,05,73	3,52,74
1911-12	Area	5,786	4,648	2,878	921	1,582
	Yield	695	913	335	251	241
	Value	10,27,08	12,06,16	4,02,03	3,06,38	2,99,89
1912-13	Area	6,826	4,493	2,414	1,158	1,575
	Yield	1,520	910	471	428	373
	Value	19,70,38	11,25,70	5,39,83	4,91,09	4,30,45
1913-14	Area	7,323	4,754	2,725	1,586	2,053
	Yield	1,614	961	308	484	612
	Value	20,88,95	12,40,89	3,98,01	5,42,38	7,08,42
1914-15	Area	7,796	4,708	2,115	1,551	1,857
	Yield	1,773	1,097	245	486	486
	Value	19,00,62	10,34,84	2,73,17	3,68,90	3,68,27
1915-16	Area	4,439	4,061	2,061	834	902
	Yield	934	1,106	245	262	195
	Value	8,20,31	8,95,51	3,57,11	1,98,21	1,36,81

Bombay.

Bombay contains a large area, especially in the Deccan, under short-staple, that can probably be extended, though not to a very large extent. In Dharwar, there is a considerable area under an American type known as Dharwar-American, that was introduced at the time of the American war. Another long-stapled cotton is grown here, known as Kumpta. Broach and Cambodia have also been introduced, but circumstances do not seem to be entirely favourable for them, and these varieties, though they may continue to be grown in small areas, are said not to be likely to spread widely. More is to be hoped from the further improvement of the existing Kumpta variety, the weak point of which is its low ginning percentage. In Gujerat cotton covers a large area, but over much of the north of the Gujerat division short-staple cotton is found. Attempts are being made to introduce a longer-staple variety, by selection from the local varieties.

The statement below supplied demi-officially by Mr. Keatinge, Director of Agriculture, Bombay, explains the general position in that Presidency :—

Area.	Type.	Length of staple in ⅛″.	Ginning percentage.	Price on January 8th, 1916.
N. Gujerat	Navsari	8—9	31	+Rs. 25 on Surat.
	Surat	6—8	32	+Rs. 15 on Broach.
	Broach	6	34	Rs. 410 (Good.)
S. Gujerat	Lalio	7	31—32	
	Waghad	6	32	
	Mathio	4	33 – 34	
Deccan	Khandesh	4	34—35	
Southern Maratha Country.	Kumpta	7—8	25	
	Dharwar-American	6	31	
Sind	Sindi	4	33	

Khandesh is a mixture, Mathio is identical with Khandesh, recently introduced into north Gujerat and rapidly spreading. Ghoghari, a short-staple variety with a high ginning percentage is beginning to spread in south Gujerat.

In Sind, the indigenous variety is short in staple, though a free yielder under the very indifferent cultivation that the local farmer affects. An attempt was made in the first instance to introduce an Egyptian type, but, though Sind can undoubtedly grow Egyptian cotton, for her to do so on a large scale and with reasonable certainty from the cultivator's point of view, a better system of cultivation will have to be introduced, and a more permanent source of irrigation will be necessary, for which extensive works on the Indus will be required.

The last report of the Imperial Cotton Specialist gives the following values for certain types recently introduced into different parts of Bombay. Dharwar Broach, with a ginning percentage of 32-33, can spin up to 40's and was priced at Rs. 375. Dharwar-Americans can spin 20's. Cambodias were valued at the Gadag auction at Rs. 320, and could spin 20's. This was on the following market basis : —

	Rs.
Sind-American	310
Madras-Cambodia	365
Navsari (Broach)	375
Superfine Bengal	250
Cambodia	340
Saw-ginned Dharwar	320
Kumpta	345

The price of Broach (good) is usually about 8 per cent. less than that of Americans (mid) but varied in the year before the war from 4 to 24 per cent. lower.

Central Provinces.

In the Central Provinces, there is a large area of short-staple cotton grown in the west and north of the province, which could no doubt be materially increased, and might perhaps be improved, but the main hope of introducing a long-staple cotton lies (1) in the light-soil areas now coming under irrigation, which, as the irrigation is in all cases by storage works, can never be very extensive, and (2) in the tracts with a rainfall somewhat higher than those hitherto regarded as most suitable for cotton in this province; here Cambodia may possibly give more profit than the short-staple.

It must not be forgotten that the length of the indigenous staple in this province has steadily declined since its cotton began to be exported. The old Berar Jari, which, it is said, would spin 15's or even 20's, has been replaced by a mixture of some six types, in which the types which mainly constituted the original Jari have tended to become less predominant, and the shorter-staple but more freely yielding types to form an increasing proportion of the mixture. This inferior mixture has also gradually spread over more and more of the area which was occupied by the superior but less prolific Bani. The operations of the Agricultural Department, which were necessarily and rightly directed towards increasing the cash yield per acre for the ryot, without consideration to the requirements of the industry, Indian or British, further added to this deterioration of quality. The most prolific variety, both in respect of yield and of ginning percentage, of the Berar mixture was found to be Roseum. This was selected for distribution, and with such success, that not less than 700,000 acres were placed under this type in 1916-17. The cash benefit to the ryot has been very great, amounting to something over a crore of rupees per annum over and above the value of the ordinary local mixture. The subject will be dealt with in further detail below, but is only mentioned here as an illustration of the fact that in the case of the varieties that can be grown at present in the cotton-producing tracts of most provinces of India the premium offered for length of staple is utterly inadequate to overcome the great difference in yield and ginning percentage between such types as the short-stapled, prolific Roseum and the long-stapled, but poorly yielding Bani. The notes of Professor Gammie, Imperial Cotton Specialist, on certain attempts which have been made in the Central Provinces to evolve a superior type, by crossing a short and a long-staple cotton, contain certain figures for the cash yield per acre of different types, and for the valuation of the new crosses as compared with existing varieties, which emphasize the above principle very strongly.

Type.	Counts.	Price. Rupees.
Bani x Roseum	20's to 22's	285
Bani x Deshi Lahore	?	295

The implication in the report is to the effect that the latter type is capable of spinning at least as high a count as the former; it has a ginning percentage of 35·5, and under the somewhat exceptional conditions under which it was grown, was a very free yielder. No definite comparison can yet be made in point of cash return between this and the local Roseum at present.

The figures below, received from Professor Gammie, are hardly encouraging:—

Species.	Yield per acre in cash. Rupees.
Cutchicum	104
Roseum	100
Bani	76
Berar Jari	74
Bani x Deshi Lahore	75

These prices sufficiently indicate, too, the reason why low-yielding long-staples like Bani and comparatively superior mixtures like Berar Jari are being rapidly replaced, in Berar and other parts of India, by free-yielding, high-ginning, short-staple varieties.

The above prices were on the following market basis:—

Variety.	Price in Rupees.
Cambodia	350
Ghat Bani	340
Fine Akola	265
Fine Khandesh	250
Indore	280
Fine Bengal	228
Superfine Bengal	240

The above basis prices also afford an indication of the relative values of the indigenous short-staple types as compared with an exotic like Cambodia.

Madras.

In Madras, there is first the long-staple Karunganni grown in Tinnevelly, till recently very largely mixed with Uppam. Efforts are being made to separate the two in order to secure a higher price for the Karunganni. Cambodia was also introduced into the same tract some years ago, and experience has shown that it can undoubtedly be grown at a profit, the yield for 1911 being estimated at 45,000 bales. The usual troubles, however, set in, owing to deterioration of that part of the crop sown on inferior lands and to adulteration. A very prolific cotton, locally called Pulichai, identical in type with the variety known as Roseum grown in Berar and Khandesh, came in a few years ago from the Deccan. Efforts have been made to stamp this out, as purely parasitic and owing its present apparent value to its use as an adulterant for the better local varieties; when it kills the value of these, as it is likely to do, unless arrested, the ryot will be left with a less profitable crop than the finer existing varieties.

In the Ceded Districts, the state of affairs is not dissimilar to that prevailing in Berar and Khandesh, and the agricultural part of the problem is being dealt with on very similar lines.

The United Provinces.

The prevailing type in the United Provinces is a short-staple cotton, which ripens early and is known to the trade as Bengals.

The position here is described by Mr. Hailey, Director of Agriculture, as follows:—"The first endeavours to improve cotton growing in the United Provinces were in the direction of introducing a long-staple cotton of American origin. The experiments began as early as 1881, but it was not until 1906 that the seed, which was then acclimatised but was of a mixed character, was distributed to cultivators in the Aligarh district. It is unnecessary here to allude to the difficulties of selling small quantities of any new type of cotton. The middlemen buy on the ginning percentage and have not been accustomed to differentiate in favour of quality. They would therefore give less for a long-staple *kapas* (seed cotton), which has a ginning percentage of 30 per cent. as compared with ordinary *deshi* with a percentage of 33 per cent. The manufacturer is not accustomed to buy *kapas* and wants the lint ginned and baled. In the absence of any other agency, it was necessary for the Agricultural Department to buy in the *kapas*, gin it, and sell to manufacturers. The cultivators were promised a bonus of Re. 1 per maund of *kapas* over the current price of *deshi*, and the lint was sold by auction. This arrangement also permitted the department to maintain purity of the seed and prevent any admixture of *deshi* seed.

"It worked well enough for three years and the cultivators usually received a bonus above the stipulated premium. But it was necessary to take an advance from Government to finance the operation, and in 1909, in consequence of the issue of orders by the then Secretary of State, the Government of India objected to the advance on the ground that it was a matter for private enterprise. As the cultivators would not sow without a guarantee from the department and no private firm would come forward to finance the undertaking, it collapsed and no more seed was distributed.

"As progress in the direction of improving the quality of the cotton seemed barred, the attention of the officers of the department was directed to improving the outturn. With this object Dr. Parr at Aligarh isolated a strain of *deshi* with a very heavy yield and a high ginning percentage of 39 to 40. It is characterised by a white flower and is known as the Aligarh white-flowered cotton. The staple is coarse and short, but the plant is hardy and a vigorous grower. In a short time it became very popular, since the buyer differentiated in its favour on account of the high ginning percentage. It is not possible to give the area under this crop, as the whole area under cotton has fluctuated so greatly of recent years, but it does not probably fall short of a lakh and a half of acres, and all the seed which the department can supply is readily bought up. Unquestionably, however, the lint is inferior to that of yellow-flowered *deshi*, and the department has always accepted the fact that, if the tide sets in steadily in the direction of better stapled cotton, a substitute must be found for this.

"Mr. Leake's hybridising experiments are directed towards this end. American cotton must be sown early and this needs irrigation. At the outside limit, the canals of these provinces could not supply water for irrigating cotton over more than 500,000 acres. The total cotton area is anything from a million to a million and a half acres, according to seasons and prices, and, therefore, there is a very big area which must always be devoted to a cotton grown in the rains. Mr. Leake's crosses are of *deshi* varieties and can be grown on this unirrigated tract. At present it is sufficient to say that trials are being made on a field scale of several varieties with an appreciably better lint than *deshi*.

"I will now turn to the revival of long-staple cotton growing. In 1912 the Elgin mills offered to finance the growing of American cotton on the basis of a premium to the cultivators of Rs. 1-4 per maund (100 lbs.) of *kapas*. After this, arrangements were to be made on the basis of spot price of middling American. In the first year the crop amounted to 120 bales. From that time to the present the lint has always been sold to one or other of the Cawnpore mills, at prices which give a premium of well over one rupee per maund of *kapas* to the grower, and in 1915 amounted to Rs. 2. The department, by an arrangement with a ginning factory, gins the whole crop in a single factory, paying the cultivators as they bring in the *kapas*. The purity of the seed is thereby maintained and the shorter strains are being gradually eliminated. For the last two years the Muir Mills have taken the whole. The crop has suffered owing to a great slump in prices in 1914 and two very wet years in 1915 and 1916, during which part of it was destroyed. It has consequently not spread very rapidly. The American cotton yields somewhat more heavily than *deshi* in ordinary years, but is more susceptible to water-logging and heavy rains. Further there has been a very great increase in the area under indigo, which has usurped part of the best cotton-growing land.

"In estimating the relative advantages to the grower of American and *deshi* cotton there are certain points to be borne in mind.

(*a*) The ginning percentage of Cawnpore-American is not more than about 31 per cent., while, as pointed out above, that of Aligarh white-flowered does not fall below 39 per cent. Consequently this defect must be made good by an appreciably higher price for the lint.

(*b*) American cotton must be sown before the rains and, therefore, on irrigated land for which canal rates have to be paid. The great bulk of *deshi* is sown in the rains.

(*c*) *Deshi* cotton is the earlier crop, and the cultivators in these provinces are in the habit of taking it up in October and sowing a *rabi* crop, such as peas mixed with barley, after it. American is longer on the ground and if a second crop is sown, late pickings cannot be taken.

"Though American cotton is sown at a time when the cultivator is ordinarily free from other work—and this constitutes its great advantage—yet it requires more care than *deshi,* and is subject to certain insect attacks, such as the leaf roller, which are of little importance in case of *deshi.* Again, American does not do well on poor soils, whereas *deshi* is often grown on the poorest lands in the village.

"Were there any great disparity of prices between the two crops, these disadvantages would fall into the background; but the prices of *deshi* have remained, except in 1914, extraordinarily good, and the demand appears to be showing no falling-off. It is most difficult to strike any balance of profit between two crops—there are so many factors to take into consideration. But it would certainly be dangerous to pronounce definitely in favour of American cotton at the premia so far obtained. It suits certain cultivators to sow their cotton early and leave themselves free for rains sowings. Others want a second crop for food purposes and prefer the shorter growing *deshi.* If there is no great difference between two crops, a backward class of cultivator will choose the hardiest, safest and cheapest crop to grow—and he is probably from his point of view amply justified."

On the same market basis as that used by Professor Gammie for Bombay (*vide* page 9), Cawnpore-Americans were valued as follows:—

Number of type.	Can spin counts.	Value. Rs.
2	30's	340
9	24's	330
1, 6, 7, and 8	20's	325
Others	16's	310

The last report of the Agricultural Department of the United Provinces contains complaints that distribution of seed was carried on under difficulties, owing to lack of subordinate staff. The smallness of the average holding rendered it a matter of difficulty to discover suitable places for private seed farms. Co-operative societies, which appear to be ordinary credit societies and not co-operative unions organised *ad hoc,* are beginning to take up the work of seed distribution, and will, it may be hoped, relieve departmental officers to some extent of this task.

The Punjab.

The Punjab probably offers the most immediately remunerative field for the dissemination of long-staple cotton of the American type. We are obtaining further information on the subject, but we have seen a statement to the effect that a single grower last year obtained an all-round yield of 250 lbs. of lint over an area of the same number of acres. More will be said below about the marketing problem in the Punjab and we shall have to obtain information regarding the land and irrigation water available for cotton growing, and in particular as to the truth of a statement, that the cotton area can be increased, if the cultivators will consent to reduce the area they sow with cold-weather irrigation; and how far such a practice is desirable, if possible. The fear of encroachment by the cotton crop on the area required by food grains is less acute in the case of the Punjab than elsewhere, seeing that only a small proportion of any particular area, which has been variously stated at one-tenth and one-sixth, can, it is alleged, be advantageously placed under cotton in any single year. A proposal was put forward by the British Cotton Growing Association some years ago, revived again by the International Cotton Spinners Federation more recently, but held in abeyance on account of the war, to take up an area in one of the canal colonies, erect gins, and demonstrate how Indian cotton can be grown and prepared for market under optimum conditions, and the grower brought into direct touch with world prices. This scheme should be examined by the Commission when they visit the Punjab.

Problem of introducing a superior type.

9. The position has now been discussed in sufficient local detail to indicate the nature of the problems before the Agricultural Department, the farmer and the trade. In the first place stands the desirability of improving the lint of the existing short-staple varieties, while maintaining the yield. This is no doubt a harder problem than that of introducing longer-staple varieties from outside; its results are likely to be very gradual in showing themselves; it involves the introduction of a cross which is capable of fertilisation by the remaining local species from which it has been built up; but it is not the less important of the two problems. The only province where this policy has been pursued steadily and consistently is the United Provinces. Some work has been done on these lines in the Central Provinces, where various crosses with the indigenous type have been produced. The work has, however, not formed part of the regular programme of the Economic Botanist, but has been carried on by the Deputy Director of the Southern Circle. In view of the highly technical character of the research problems involved, this is certainly the duty of a botanist, and should be taken over by him. A much more general and sustained effort is needed for the solution of this problem than has been made hitherto, outside the United Provinces.

The short-staple crop is of great importance in the Central Provinces and Bombay, and to a less extent in Madras and the United Provinces. The Economic Botanists of these provinces have their hands already fully occupied with other work; and there would be ample employment for at any rate another botanist in each of the first two provinces for the study of this single problem. An increase of under a penny a pound in the value of the cotton produced in the 14,000,000 acres which grow the short-staple crop at present, would yield over 6 crores of rupees, justifying amply the immediate expenditure proposed.

We now turn to the consideration of the next problem, *viz.*, the introduction of a long-staple type, whether exotic or built up by crossing. In order to make the substitution as rapid as possible, and to obtain the advantage of a uniform type, some organisation for securing the distribution of seed true to type on a wide scale, at the minimum of cost and with the greatest probability of becoming a permanent local institution, is necessary. Such an organisation is undoubtedly to be found in the co-operative system of seed distribution. Under this system as worked in Berar, the Government farm distributes as much of the required seed as it can grow to central farms, attached to co-operative unions, but inspected by Government agency. These farms sow that seed, and distribute the seed in the second year to the seed farms of private individuals, members of the union, who grow it and sell it to the public in the third year. Where necessary, each union gins its own cotton, thereby ensuring the purity of the seed, which is apt to deteriorate and is liable to adulteration in ordinary commercial gins. The seed farms of the private members are inspected by an agency employed by the union, but trained and supervised by the Agricultural Department. Funds are found by members contributing to their unions from the profits they make by the sale of the improved seed at a rate higher than the bazaar rate. The extent to which seed distribution can be extended by this agency, when no other difficulties supervene, may be judged by the fact that in the Central Provinces an area of 700,000 acres was estimated to have been sown by this means during the year 1916-17. To increase the yield of an existing type, by the dissemination of a variant of the same type, yielding more seed cotton (as opposed to lint or ginned cotton), is easy. Adulteration is not a serious drawback, especially when, as in Berar, the cotton which it is sought to introduce is a specially short staple variety, which is proof against adulteration, owing to its low quality.

10. The next degree of difficulty is reached when the main advantage lies, not in an increased gross yield of seed cotton, but in an increased yield of ginned cotton. The difference is not, however, one of kind, but of degree. The damage wrought by admixture is still small, and only the most short-sighted purchaser would attempt to snatch a transitory profit by refusing to pay prices based on the larger yield of lint. In a tract where, as is almost everywhere the case in India, gins abound, this refusal is not likely to be effective for long, and can in any case be overcome by departmental or co-operative ginning.

11. The real difficulty, however, arises, when the advantage in growing a new type lies not in quantity but in quality, such as strength, softness, colour or length of fibre. In the first place stands the necessity of securing improved cultivation. Apart from this, however, the difference in price is seldom marked enough to appeal to the grower, unless an absolutely pure strain of seed is obtained by him, and an absolutely unmixed yield marketed by or for him. Any admixture of a cheaper variety is fatal to price. At the same time, the existence of a superior type encourages an inferior type as an adulterant (as was shown above in the case of Pulichai in Madras), which will eventually kill the superior type, owing to the fact that its presence in increasing proportion lowers the price very rapidly, so that eventually it is not worth the grower's while to grow the superior type, since the reputation of the local name goes down, and he cannot get more for the pure than for the mixed variety.

Various means have been adopted in order to resist this evil, which arises in one form or another in every part of India where an improved variety has reached the position of a commercial crop.

Pure seed, as has been shown above, can always be supplied on a moderately large scale by a Government agency, and distributed through a certain number of private seed farms, supervised by a departmental agency, so long as some profit can be guaranteed to the grower, by a higher price either for his seed or his lint. Guarantees to this effect are often given by Government to start with, and were found necessary even in Berar at first.

The evil effect of gins in causing seed mixture, though real enough, can be combated by special arrangements. These arrangements, however, when the production reaches any considerable figure, impose a heavy burden on the expert agency, which is undesirable; while the gins are also in many cases the worst offenders in the matter of lint adulteration. To meet these difficulties it has been suggested that a system of licensing gins should be set up, by which they would be compelled to keep the seed and lint of certain types of cotton unmixed, under penalty of forfeiture or suspension of license. This is a point on which evidence is desirable in Bombay and the Punjab. It seems hardly necessary to carry legislative interference beyond the gin-owner, although the case must be provided for when the cultivator or dealer brings a mixed lot of cotton to the gin. The next difficulty lies in getting the pure cotton into the hands of the buyer, whether ginner or merchant, and in obtaining the maximum value from him. In Madras arrangements have been made for ryots to sell improved Karunganni on joint account direct to ginning firms. A scheme has also been worked with some success by a league of the principal buyers with the Agricultural Department, who refuse to purchase cotton which contains any admixture of the inferior Pulichai. This latter device is no doubt likely to be effective in cases where an obnoxious newcomer can be stamped out in a short campaign of a year or two.

The history of the work in Bombay is most instructive. Broach cotton introduced into Dharwar is being sold by auction after departmental grading. Obviously this action cannot be very widely extended by a departmental agency on the existing scale. In lower Gujerat, where an attempt was being made to improve the quality of the lint, a syndicate formed by Bombay mill-owners undertook to pay 5 per cent. above the prevailing rate for the improved Broach cotton with a higher ginning percentage. (It is desirable to enquire if this rate was fair.) As soon, however, as the area sown became considerable, difficulties arose which led to a breakdown of the scheme. There was a doubt as to what the local prices were. Local buyers offered higher prices for the improved cotton, and the syndicate were called on to pay their increment on the prices so enhanced. The ryots also rigged the market, or at any rate reported sales which were believed to be fictitious. Cultivators brought in their cotton when prices were high, and held it back when they fell. During the second year of operations, there was a steady fall in prices, and the ryots who held back their cotton, got lower prices in the end; the loss so incurred seems to have been associated in their mind, quite unfairly, with the operations of the syndicate. Further, the cotton bought up-country by the syndicate was reported to have been received in Bombay in an adulterated condition. The information at our disposal regarding the extent to which the syndicate bought direct, and through what agency, and the methods adopted by the Agricultural Department to secure that the cotton came forward in a pure condition, is not sufficient to show how this happened. In Sind, the syndicate erected saw gins, as the local roller gins were not suitable for dealing with the American type. The Deputy Director thought that the syndicate should have secured a larger proportion of the crop produced. There were also difficulties arising from inferior methods of cultivation, failure of canal water, and shortage of seed. The syndicate withdrew from Sind for one year, but has since agreed to make another start. It was stated in evidence by Mr. Henderson, Deputy Director in Sind for some years, that local conditions are unfavourable to co-operation, and the most promising organisation for seed distribution is through the personal influence of leading landlords.

Only small quantities of long-staple cotton have been grown in the Central Provinces, and their inspection and marketing was effected departmentally, the Empress Mills in all cases proving a ready purchaser for full value. The growing of improved wheat through co-operative agency in this province throws an interesting light on the possibilities of a co-operative marketing organisation for obtaining value for quality. The increased value in this case is relatively small, and the cost of sowing an acre very high, compared to cotton, but a considerable degree of success has been obtained through co-operative sales, with the help of one of the big export purchasing firms.

We have unofficial evidence of considerable interest, regarding the state of affairs in the Punjab, but it will require verification by local enquiry. To start with, the market for cotton in this province was in a far less organised state than in other provinces where more cotton is grown. Local buyers at first refused to pay more for a longer staple; indeed, the big exporting firms, it is alleged, tried to discourage the growth of such types, as it complicated the market, and required the use of expert knowledge which their buyers did not possess. A system of Government auctions was introduced, where buyers had to undertake to have the cotton ginned at specified gins under supervision. Prices 45 per cent. above the local rate were obtained at these auctions. On one occasion at any rate before the auction system was introduced, a big exporting firm had sold in Liverpool at *9d.* a pound cotton bought in the Punjab at *4d.*; Bombay buyers, however, gave better prices.

12. This question of improvement has been considered in a good deal of detail, inasmuch as it applies, not only to the introduction of exotic, but to any improvement of the existing varieties. Moreover, sufficient experience has been obtained to show where the difficulties lie, and where help is needed. The problem of inducing the grower to offer a pure type of cotton and the purchaser to give him full value for it, has not yet been solved, though several of the schemes so far devised look promising. The help and goodwill of the mill-owners or other buyers is readily forthcoming. The former no doubt realise that their being first in the field and in a position to secure the pure type in bulk offers them the best chance of being able to keep the long-staple cotton for their own mills in case of outside competition. A free market, however, for long-staple cotton in this country is necessary, if the cultivator is to get the world price for it, and any attempt to restrict this will prove fatal to the introduction of superior types. Little effort seems hitherto to have been made, except perhaps in Madras and the Punjab, to enlist the support of the intermediate local buying interests, often merchants of the Marwari class, who are the most to blame at present for the adulteration of improved types. The attempt is surely worth making, difficult as it undoubtedly is. No satisfactory evidence is forthcoming of the extent to which Indian long-staple cotton commands world prices in Indian markets. Statement No. II appended to this note seems to show that local prices for Tinnevellies followed the world prices for Americans more closely than Westerns, a superior cotton which relies mainly on the Indian demand. The fact that Tinnevellies are regularly quoted on the Liverpool market accounts for this, though the difference between Indian and Liverpool prices was often large, especially when the freight position became more difficult. Finally, it is clear that the first step to take is to devise some means to ensure the cotton coming forward in bulk, unmixed, and if possible, through some organic agency, capable of ultimately taking care of itself with a minimum of Government intervention; or at any rate of being carried on for as many years as possible, until an established course of trade hostile to adulteration has grown up. In small areas, departmental action might serve, but this is impossible over really large areas. In such cases, co-operation seems the most promising means; but it must be recollected that co-operation will not flourish in a soil that has not already been inoculated with its own microbe; we mean that the way to co-operative distribution must in India be paved by acquaintance with and acceptance of the benefits of co-operative credit. Communities accustomed to co-operative credit are suited for the development of an organisation for the sale of a given type of cotton on joint account. There will, however, be many

cases where, for various reasons, the people are either unsuited or unready for co-operative working; and here departmental agency, aided by an ever increasing proportion of help by the trade, seems to offer the best chance of success. The temptation of adulteration is, however, great, where the variety to be introduced is of high quality; and departmental agency must be largely relied on for a long time to replace or supplement co-operative organisation. This will necessitate large additions to the existing staff. The problem of maintaining and marketing a pure type seems so difficult and so urgent, that it deserves for the present as much attention as the purely agricultural problem of producing the type itself.

Conditions under which ryot markets his crop.

13. These conclusions bring one to a consideration of the conditions under which the cotton crop is normally marketed in India. These do not in most cases differ greatly from those prevailing in the case of other export crops. A varying proportion is taken over by merchants or money-lenders who have given advances to the growers, or to whom the latter are indebted. But still a very considerable proportion, naturally more considerable in areas where the average cultivator's holding is larger, is brought by the latter to the market town. In this case the cultivator sometimes sells to a ginnery; sometimes he takes it about from one dealer to another to obtain the best price. In other cases, again, he takes it to a cotton market; where these are well organised, with proper regulations and supervision to prevent the grower being imposed upon, the benefit to the cultivator is great, and he resorts freely to the market. The result is the elimination of unnecessary intermediaries, with profit to grower and mill-owner. An example of such a system is to be found in Berar, where a set of rules has been framed under which cotton markets are constituted and managed. The essential features of this system, which has been described fully in a note by Mr. Standen, Commissioner of Berar, are as follows:—

Commission agents, brokers and weighmen are licensed. The weights used are prescribed and inspected. Trade allowances are forbidden. The prices for the day are not published by the market committee, but become known at once in the market. Unginned cotton is inspected after removal from the market to a gin, and deductions made from the price on account of any defects. The seller need not accept these deductions and may resell his cotton if he likes.

The system, though capable of improvement, works well, and is strongly approved of by the growers. In the absence of such a special organisation, though the grower may have a pretty fair idea of the price he ought to get, yet, owing to the various tricks that are played at his expense by the buyers and the intermediate agents, he does not get it. It seems probable that much could be done for the cultivating classes by a better organised market system. In the case of export crops in particular, it would lend itself to any efforts that may be made to secure price for quality, at any rate after the initial stages had been passed. The necessity of this should be strongly pressed on Local Governments. The tendency in India is to accept as inevitable too many intermediate profits in the up-country period of the movement of an export crop. As the benefits of the co-operative movement spread, the improvements of markets will become a more urgent question. The growers who receive advances on their crop or who sell it to their creditors, in each case on unfavourable terms, will tend to become less numerous; the cultivating classes generally will demand a higher standard of efficiency in marketing, and will be less tolerant of excessive profits at their expense. Something, too, may be done, and is in places being done, by teaching cultivators a few points about marketing their crops.

Adulteration.

14. Proposals for penalising the fraudulent adulteration of cotton have been more than once put forward by various bodies in England and India. Correspondence in the records of the Government of India regarding the proposals made by the International Confederation of Cotton Spinners to Lord Crewe in 1911 may be referred to in particular. We do not propose to touch on the question of mixing cotton of higher with that of lower grades by other agencies than the gins. The experience of the working of the Cotton Frauds Act in Bombay has shown the dangers attending Government action in this matter. Similarly the watering of unginned cotton is in the first place not practised on a relatively large scale and can be put a stop to by the action of the ginners. The watering of ginned cotton by the balers is, however, a much bigger matter; it is done on a large scale and in a thoroughly organised manner, pipes and hoses being used for that purpose in many press compounds, especially in Berar. This might be dealt with without any Government inspecting staff, by allowing the private prosecution (with the sanction of Government, to prevent vexatious proceedings) of any person who actually watered cotton. This might no doubt be effected by a trade organisation; if no action were taken, no harm would be done, and the law would be temporarily ineffective. If necessary, it might be introduced for a term of years in the first instance, and, if not used, could be allowed to disappear automatically from the statute book. Opinions on this point might be invited in Bombay.

Mechanism for carrying out recommendations.

15. The proposals that have been put forward in this note are as follows:—

(1) To improve the existing short-staple types of cotton, by developing, through crossing or selection, a longer and better fibre, while maintaining the high outturn of the low quality type.

(2) In areas where the conditions admit of it, to continue and intensify the present attempts to introduce longer-staple exotic cottons.

(3) To make more determined and systematic efforts to provide a free and effective demand for improved cottons, and to see that they reach the buyer in a pure and unadulterated condition.

(4) To improve marketing arrangements generally, and to prevent some of the more dangerous forms of adulteration.

With regard to (1) it has been stated in paragraph 9 above that the problems indicated are sufficiently difficult and important to justify the appointment of two or three botanists, specially deputed for this work. The improvement of Indian cotton is an urgent matter. It is however possible to speed up research work by the employment of increased staff. This may be done either by tackling more individual problems at once, or by dealing with each individual problem intensively, *e.g.*, by following each experiment through all the life history of the plant in detail, instead of merely recording final results. The strength of the expert staff and the problems which they should take up should be settled by an authority competent to form an opinion on a consideration of the whole aspect of the case, both scientific and economic. In this connection it may be remarked that the Board of Agriculture, as at present constituted does not seem the right kind of body for this purpose. It is too unwieldy, too overburdened with details, and is not equipped for giving adequate consideration to the economic and especially to the industrial aspect of a question like this. Such a body can hardly decide, for instance, to what extent should a staple spinning 20's be aimed at, rather than one spinning 40's. The botanists selected should be required to work at the problems prescribed for them and should not be allowed to alter these, without the sanction of an authority not less competent than that which decided the original lines.

The above are, it is thought, the principles which are best calculated to give the speediest results and in the most economical way. But the task will in any case be a long and difficult one. It is hard for a non-expert to realise what a lengthy, laborious and uncertain process is the building up of a new type. Line after line of work proves infructuous; characters cannot be fixed in combination with other characters; differences are small at first; the plants can be crossed in a single operation, but the botanist can do nothing all the rest of the twelve months but patiently await the result of this single act; and the slightest mistake or accident wastes a whole year. It has taken Mr. Leake, for instance, ten years to arrive only at the beginning of a very promising development. Results, however, occur in a satisfactory proportion of the lines taken up, if the choice is made on reasonable grounds, and the prizes of success are enormous. A gain of six crores of rupees has been mentioned above as the possible result of one particular line of work. That there is nothing improbable in this expectation may be shown by the fact that in the Central Provinces we found that, merely as a result of a botanical examination of the mixture of cottons grown in that province and the selection of the best type of the most profitable of those varieties, an annual addition of over one crore of rupees to the wealth of the local cultivators has been already made by the local Department of Agriculture, over an area of 700,000 acres sown with the seed supplied by Government.

With regard to the third point, this very necessary work is at present carried out by the expert staff of the Agricultural Department, often, it would seem, to the neglect of their more technical duties. Some arrangement should be made, either for the undertaking of these duties by a less highly trained but equally reliable class of Government employé, or for their performance by some non-Government agency.

The improvement of marketing arrangements should be taken up by Government, not only as a necessary condition for the dissemination of improved crops, but in the interest of the people generally. A great benefit would be conferred on the cultivator, and no doubt on the consumer, if the former could be given a market, where buyers would compete freely for his grain or other articles, and he would be reasonably safeguarded from the more undesirable manœuvres of brokers, touts and their allies. The matter might be enquired into, at any rate in the larger provinces, by officers deputed for this purpose; and such system of market supervision might be adopted as the result of the enquiry seemed to indicate as suitable. Moreover, the maintenance of a high standard of efficiency in the supervision of markets should thereafter form a part of the regular policy of Local Governments; a Collector should think it no less a part of his duty to see that his local markets were so arranged as to secure for the grower a fair share of the price and not to add unnecessarily to the cost of the article to the consumer, than to secure efficient sanitation by a Municipality or road-making by a District Board. The proper authority to undertake the supervision of marketing arrangements and of gins is probably the Director of Industries, but the point requires further examination.

STATEMENT No. I.

(*a*) QUANTITY.

Production (in bales of 500 lbs.) as given at page 395 of Professor Todd's book on "The World's Cotton Crops."

	America.	India.	Egypt.	Russia.	China.	Other Countries.	TOTAL.	Consumption (as given on page 410 of Todd's book) in bales of 500 lbs. TOTAL.
1902-03	10,758,000	3,367,000	1,168,000	342,000	1,200,000	801,000	17,636,000	...
1903-04	10,124,000	3,161,000	1,302,000	477,000	1,200,000	751,000	17,015,000	...
1904-05	13,557,000	3,791,000	1,263,000	536,000	756,000	803,000	20,706,000	...
1905-06	11,320,000	3,416,000	1,192,000	604,000	788,000	936,000	18,256,000	...
1906-07	13,551,000	4,934,000	1,390,000	759,000	806,000	1,027,000	22,467,000	20,605,000
1907-08	11,582,000	3,122,000	1,447,000	664,000	875,000	950,000	18,640,000	21,053,000
1908-09	13,829,000	3,692,000	1,150,000	698,000	1,933,000	969,000	22,271,000	22,387,000
1909-10	10,651,000	4,718,000	1,000,000	686,000	2,531,000	950,000	20,536,000	22,318,000
1910-11	12,132,000	3,853,000	1,515,000	895,000	3,467,000	967,000	22,829,000	24,605,000
1911-12	16,043,000	3,288,000	1,485,000	875,000	3,437,000	1,058,000	26,186,000	26,126,000
1912-13	14,129,000	4,395,000	1,507,000	911,000	3,931,000	1,171,000	26,044,000	26,863,000
1913-14	14,610,000	5,201,000	1,537,000	1,015,000	4,000,000	1,340,000	27,703,000	27,000,000
1914-15 *Estimates.*	16,500,000	5,000,000	1,300,000	1,300,000	4,000,000	1,300,000	29,400,000	...

(*b*) VALUE (IN RUPEES).

1902-03	2,16,84,09,000	32,45,82,000	18,95,81,000	5,42,28,000	14,91,06,000	11,70,57,000	3,00,29,63,000	...
1903-04	2,46,77,25,000	32,14,18,000	28,38,36,000	7,56,34,000	15,51,69,000	13,00,62,000	3,43,38,44,000	...
1904-05	2,60,54,86,000	48,39,05,000	27,73,07,000	8,49,89,000	12,25,23,000	14,05,18,000	3,71,50,28,000	...
1905-06	1,69,02,17,000	35,76,12,000	22,46,92,000	8,16,55,000	10,13,36,000	13,22,15,000	2,58,77,27,000	...
1906-07	2,32,23,03,000	58,64,52,000	33,98,55,000	11,28,77,000	11,23,78,000	16,90,22,000	3,64,28,87,000	3,39,08,10,000
1907-08	2,14,70,13,000	35,99,89,000	39,78,35,000	10,81,84,000	13,62,99,000	16,99,16,000	3,31,92,36,000	3,76,58,55,000
1908-09	2,25,75,84,000	41,96,96,000	24,30,09,000	10,49,09,000	24,69,10,000	14,85,04,000	3,42,06,12,000	3,43,08,08,000
1909-10	2,00,77,13,000	58,61,87,000	24,20,62,000	10,83,63,000	42,20,97,000	16,71,11,000	3,53,35,33,000	3,92,51,78,000
1910-11	2,85,17,78,000	60,02,85,000	51,48,16,000	16,66,90,000	58,95,89,000	21,02,22,000	4,93,33,80,000	5,34,85,12,000
1911-12	3,25,47,24,000	54,30,68,000	40,03,33,000	14,80,02,000	62,85,95,000	21,02,66,000	5,19,09,88,000	5,19,25,42,000
1912 13	2,53,08,57,000	64,74,38,000	39,29,50,000	14,37,81,000	70,66,59,000	21,65,92,000	4,63,82,77,000	4,96,79,76,000
1913-14	2,91,18,56,000	80,74,01,000	44,15,03,000	16,09,41,000	74,20,00,000	27,71,46,000	5,34,09,47,000	5,58,39,37,000
1914-15	2,94,83,44,000	56,95,83,000	31,97,19,000	20,61,31,000	57,23,75,000	22,15,35,000	4,83,76,87,000	...

NOTE.—The valuation has been made on the basis of the prices prevailing in the different years.

STATEMENT No. II.

Showing the prices of 'Tinnies' at Tuticorin *as compared with those at* Liverpool.

Period.	PRICES PER lb. IN ANNAS AND DECIMALS.				PRICE PER BALE OF 500 lbs. IN £ AND DECIMALS OF £.		
	American middling at Liverpool.	Tinnevelly at Liverpool. F. G. F.	Tinnies at Tuticorin, F. G. F.	Westerns per lb.	American middling at Liverpool.	Tinnevelly at Liverpool, F. G. F.	Tinnies at Tuticorin, F. G. F.
1	2	3	4	5	6	7	8
					£	£	£
31st December 1914 .	4·58	4·00	3·20	2·88	9·54	8·33	6·67
15th January 1915 .	4·80	4·24	3·52	2·88	10·00	8·83	7·33
29th January 1915 .	5·02	4·54	3·20	3·52	10·46	9·46	6·67
12th February 1915 .	4·97	4·54	3·52	3·36	10·35	9·46	7·33
26th February 1915 .	4·97	4·54	3·52	3·68	10·35	9·46	7·33
12th March 1915 . .	5·17	4·81	3·68	3·78	10·77	10·02	7·67
26th March 1915 . .	5·48	5·14	4·19	3·97	11·42	10·71	8·74
16th April 1915 . .	5·75	5·44	4·42	4·06	11·98	11·33	9·20
30th April 1915 . .	5·66	5·40	4·48	4·45	11·79	11·25	9·33
14th May 1915 . .	5·30	5·10	4·16	4·16	11·04	10·62	8·67
4th June 1915 . .	5·35	5·15	4·06	...	11·14	10·70	8·47
11th June 1915 . .	5·37	5·20	4·03	3·60	11·18	10·83	8·40
25th June 1915 . .	5·20	5·10	3·94	3·58	10·83	10·62	8·20
9th July 1915 . .	5·17	5·00	3·84	3·65	10·77	10·42	8·00
23rd July 1915 . .	5·13	5·05	3·78	3·57	10·69	10·52	7·81
6th August 1915 . .	5·53	5·25	4·00	3·36	11·52	10·94	8·33
20th August 1915 . .	5·42	5·15	4·00	3·36	11·29	10·73	8·33
3rd September 1915 . .	5·78	5·40	4·10	3·74	12·04	11·25	8·53
17th September 1915 .	6·14	6·05	4·80	4·00	12·78	12·60	10·00
1st October 1915 . .	6·97	6·43	4·80	4·72	14·52	13·40	10·00
15th October 1915 . .	7·23	6·85	5·31	4·83	15·06	14·27	11·07
29th October 1915 . .	7·02	6·65	4·96	4·86	14·62	13·85	10·33
12th November 1915 .	7·01	6·60	5·02	4·17	14·60	13·75	10·47
26th November 1915 .	7·28	6·90	5·06	4·64	15·17	14·38	10·53
11th December 1915 .	7·66	7·25	5·06	4·64	15·96	15·10	10·53
25th December 1915 .	...	...	4·86	4·48	...	...	10·13
31st December 1915 .	7·92	7·50	...	...	16·50	15·63	...
14th January 1916 . .	8·79n	7·75	5·50	4·74	18·83	16·15	11·47
29th January 1916 . .	7·93	7·70	5·54	4·86	16·52	16·04	11·53
11th February 1916 .	8·06	7·75	5·54	5·40	16·79	16·15	11·53
25th February 1916 .	7·72	7·50	5·79	5·63	16·08	15·63	12·07
17th March 1916 . .	7·87	7·65	6·03	5·89	16·40	15·94	12·53
31st March 1916 . .	7·77	7·50	6·08	5·76	16·20	15·63	12·67
14th April 1916 . .	7·78	7·55	5·82	5·42	16·22	15·73	12·13

STATEMENT No. II—*contd.*

Showing the prices of 'Tinnies' at Tuticorin *as compared with those at* Liverpool—contd.

Period.	PRICES PER lb. IN ANNAS AND DECIMALS.				PRICE PER BALE OF 500 lbs. IN £ AND DECIMALS OF £.		
	American middling at Liverpool.	Tinnevelly at Liverpool, F. G. F.	Tinnies at Tuticorin, F. G. F.	Westerns per lb.	American middling at Liverpool.	Tinnevelly at Liverpool, F. G. F.	Tinnies at Tuticorin, F. G. F.
1	2	3	4	5	6	7	8
					£	£	£
28th April 1916 . .	7·94	7·65	5·79	5·50	16·54	15·93	12·07
12th May 1916 . .	8·44	8·10	6·05	5·80	17·58	16·87	12·60
26th May 1916 . .	8·47	8·10	6·02	5·26	17·65	16·87	12·53
9th June 1916 . .	8·42	8·00	6·14	5·76	17·54	16·67	12·80
23rd June 1916 . .	8·29	7·90	6·14	5·89	17·27	16·46	12·80
7th July 1916 . .	8·04	7·65	6·24	6·08	16·75	15·94	13·00
21st July 1916 . .	7·97	7·65	6·27	6·05	15·60	15·94	13·07
4th August 1916 .	8·57	8·20	6·53	6·50	17·75	17·08	13·60
18th August 1916 . .	8·86	8·45	6·34	6·62	18·46	17·60	13·20
1st September 1916 . .	9·90	9·20n	6·72	6·88	20·63	19·17n	14·00
16th September 1916 .	9·51	8·95n	6·59	6·78	19·82	18·65n	13·73
29th September 1916 .	9·47	8·90n	6·53	6·78	19·73	18·54n	13·60
13th October 1916 . .	10·11	9·40n	6·85	6·78	21·06	19·58n	14·27
27th October 1916 .	11·14	10·40n	6·82	...	23·21	21·66n	14·20
10th November 1916	11·42	10·90n	6·75	7·26	23·79	22·71n	14·07
24th November 1916 .	11·90	11·30n	7·49	7·46	24·79	23·54n	15·60
8th December 1916 . .	12·05n	11·45n	8·00	7·74	25·10n	23·85n	16·67
22nd December 1916 .	10·09n	9·65n	8·00	7·42	21·02n	20·10n	16·67
5th January 1917 . .	10·96n	10·45n	...	...	22·83n	21·77n	...
19th January 1917 . .	...	...	...	...	...	...	...
2nd February 1917 . .	10·33n	9·90n	...	...	21·52	20·63n	...

APPENDIX C.

THE SUGARCANE INDUSTRY.

Sugar problem in India.

The sugar problem in India is capable of being stated very simply. In the last year before the war (1913-14), the area under cane in the provinces for which returns are received was 2,659,800 acres, from which a normal yield of *gur* would be 3,428,000 tons. *Gur* is also produced in some provinces from palm trees to the extent of about 150,000 tons, but the quantity apparently does not vary much from year to year, and has not been affected by the war. In the year 1913-14 the imports of sugar and molasses together were 896,800 tons. To what extent can these imports be replaced by sugar produced in India?

Production in India.

2. During three years of war the average annual imports of sugar have decreased by 256,000 tons, whilst the increased area brought under cultivation is capable of producing about 350,000 tons of *gur*. The tables given below furnish the data upon which the above statement is based.

TABLE I.

Provinces.	Normal yield of *gur* in tons per acre.	1913-14.		1917-18.	
		Area in acres.	Outturn in tons.	Area in acres.	Outturn in tons.
Bengal	1·3	216,500	281,400	207,000	269,100
Bombay	3·1	63,500	196,800	113,000	350,300
Madras	2·2	83,600	183,900	123,000	270,600
United Provinces	1·2	1,389,300	1,667,200	1,497,000	1,796,400
Bihar and Orissa	1·1	262,900	299,200	263,000	289,300
Punjab	0·9	410,800	369,700	502,000	451,800
Central Provinces	1·1	20,400	22,400	25,000	27,500
Assam	0·9	37,900	34,100	35,100	31,500
North-West Frontier Province	2·0	31,800	63,600	31,000	62,000
Minor Areas	1·3	24,900	32,400	22,000	28,200
Total	...	2,541,600	3,150,700	2,818,000	3,576,700
Native States	1·5	118,200	177,300	(not available).	
TOTAL	...	2,659,800	3,328,000	...	...

Table I gives the area under sugarcane in 1913-14 compared with the final forecast of 1917-18. These areas multiplied by figures furnished by the Agricultural Department for the average outturn per acre of each province give the weight of *gur* produced in a normal year from the area under cultivation. From the statement it will be seen that in 1913-14 the crop in British India, if the yield was an average one, was 3,150,000 tons, and in the Native States from which returns are received 177,000 tons; whilst in 1917-18 on the same assumption the crop in British India will be 3,576,000 tons, an increase of 426,000 tons. Figures for the Native States are not yet available, but it is fairly certain that they would show a somewhat similar increase, *viz.*, 13 per cent., and we may, therefore, assume that the total increased production of India will be about 450,000 tons. Areas for which no figures are furnished are the Native States of Hyderabad, Baroda, Baluchistan and Sikkim.

TABLE II.

Year.	Imports of sugar in tons.	Value in £ sterling.
1912-13	772,153	9,519,172
1913-14	896,869	9,971,251
1914-15	550,120	7,014,990
1915-16	642,744	11,078,531
1916-17	542,218	10,300,210

Table II furnishes the imports of sugar into India from outside with the values expressed in sterling for the five years 1912-17. The rapid increase in the rate of importation came to an end with the outbreak of war. In the two years immediately preceding the war, imports averaged 834,000 tons; whilst in the three years of war they have fallen to an average of 578,000 tons, a decrease of 256,000 tons. The expenditure on foreign sugar shows little change; the average annual imports in the pre-war years referred to were valued at £9,748,000 and in the war years at £9,469,000. That is to say, the fall in volume of imports was almost exactly counterbalanced by the rise in price. From this it would seem that India is able to spend about ten millions sterling a year on sugar, which may be regarded somewhat in the nature of a luxury, and that for her ordinary dietary *gur* is sufficient. The rise in the price of sugar diminished the quantities consumed, and this deficiency has been made up by an equivalent amount of *gur*. The increase in cane cultivation is a very satisfactory feature of the situation, and justifies the expectation that the efforts now being made by the Government to raise the standard of agricultural practice will result in a very marked advance in the industry, both as regards area cultivated and yield of crop.

It will be observed from Table I that cane cultivation is very unequally distributed throughout India and that by far the greater area is situated in the alluvial plains of the Ganges and Indus river systems. The weight of the cane crop per acre in the south of India is, however, much greater than in the north, where the cold season is too prolonged to yield, at any rate with the present types of cane, the returns obtained in the warmer and more equable climate of the south. Further the percentage of available sucrose, upon which the weight of *gur* extracted depends, is appreciably larger. In Bombay and Madras, too, the cultivation is better, irrigation is fuller, and manuring is on a far more liberal scale. Cane growing in these southern provinces is, however, dependent for its extension on storage irrigation, though much may be done also by power pumping from wells or rivers. Any large increase from wells worked by bullock power is not to be expected. In the United Provinces and the Punjab, where snow-fed canals exist on a large scale (by far the most economical form of irrigation for a crop requiring water during the hot weather), climatic conditions are less favourable, but the cane areas are larger than those of the southern provinces. A very large acreage is grown in Bengal, Bihar and the United Provinces, practically speaking without irrigation. In the United Provinces, even where irrigation is given, it is mostly very scanty, except where canes are grown for chewing; and it is improbable that it can be materially increased. In the small, highly-cultivated cane areas of Madras and Bombay, and to a less extent in the Central Provinces, the work of the Agricultural Departments has been more effective than in the large, ill-cultivated cane areas of the small and poor cultivators of the United Provinces.

Agricultural improvement. Results of past working in the provinces.

3. The main line along which the problem must be attacked is obviously that of agricultural improvement. The policy should be generally to continue the improvement, along existing lines, of the Madras and Bombay crops; to introduce varieties into the northern provinces which will give the best results under existing conditions of temperature, water supply and climate; and to induce the growers of the northern tracts to take up, along with better types of cane, higher manuring and cultivation. The extension of irrigation in the southern provinces will doubtless be continued on the lines best calculated to obtain for the growers the greatest benefit in return for the money expended. Some share of this is bound to fall to sugarcane. It has been found that in Bombay, at any rate, cane growers are ready to pay as much as Rs. 60 per acre for the irrigation of thick varieties, and it seems hardly necessary to press the claims of cane to any special treatment in these areas.

Madras.

Turning to the purely agricultural work done in the various provinces, we find that in Madras considerable improvements have been effected by the introduction of a disease-proof cane, with the result of arresting the decline of the cane area in the deltaic tracts. Improved methods of cultivation have also led to an increase in the area under cane, owing to the larger profits thereby obtained. No estimate is available to the Commission of the probable increased area to be looked for owing to greater irrigation facilities, or of the amount of improvement in the yield per acre that the Agricultural Department has in view.

Bombay.

Mr. Keatinge, the Director of Agriculture, anticipates that, out of the areas in Bombay over which irrigation is now to be extended, some 80,000 acres are likely to be planted with cane. The Agricultural Department, by an application of water and manure in quantities actually less than those given by the local growers, secured a crop in 1915-16 of 50 tons of cane yielding six tons of *gur* per acre. The use of ammonium sulphate together with oil cake in addition to farmyard manure was found to be the most economical form of manure. Sulphate of ammonia is admittedly suitable for sugarcane in many parts of India; and the general adoption of coke-oven recovery plants on the coal fields should lead to an increased supply at a lower price, which would be a great benefit to the cane industry.

Central Provinces.

In the Central Provinces the agricultural improvements at present being demonstrated, though promising enough in their way, are not likely to make any very large difference to the gross yield, as the area under cane is so small. Much, however, depends on the quantity of water likely to be made available for cane as the result of the numerous irrigation works under construction or projected in this province. The irrigation of cane from storage works in this part of India does not, judging from the history of the past few years, seem very promising, owing to the heavy losses from evaporation and leakage in channels, when small quantities of water are passed along them in the hot season. The extension of the storage capacity of the reservoirs feeding the Mahanadi canals may, however, afford a largely increased supply of water for cane. Very high yields can be obtained in the south of the Central Provinces where conditions approximate to those in Bombay or Madras.

United Provinces.

An important factor in the United Provinces is the result expected from the crosses which are being produced in the experimental area in Coimbatore. But Dr. Barber, the Sugarcane Expert, reports that he will not be able to test these and give them out to the Government farms for local trial till 1921. If a seedling cane, combining the hardiness and resistance to unfavourable climatic conditions of the local United Provinces varieties with something of the increased yielding power of thicker exotic species, can be evolved, then the prospects of increased production on, and extension of, the existing area are very hopeful. But in order to make this possible, the ryots must be induced to improve their cultivation and to adopt an altogether different standard of manuring. Meantime, the report of the meeting of the Board of Agriculture in 1916 states that a Java variety can be grown successfully in the United Provinces, with slight modifications of the local agricultural methods, to yield 70 per cent. juice in a nine-roller mill, with 15 per cent. sucrose, while the local varieties, under the same conditions give only 55 per cent. juice, with 10 to 11 per cent. sucrose. The above are the results of crushing on a considerable scale at the Rosa factory, and the variety in question, which was grown by the factory, has been thoroughly tried in other parts of the United Provinces. The prospects seem very favourable, and all now depends on a successful demonstration campaign. It will be necessary to provide very large quantities of manure in the form of oil cake, for it is at least doubtful if the local supply of farmyard manure can be greatly increased in the near future.

The United Provinces Government is taking steps to popularise the use of mahua cake as a manure for cane. The example of Formosa,* where the Japanese Government advanced £2 worth of fertilisers for every 2·4 acres put under cane, on condition that the cultivator himself spent another £2-10*s*. On fertilisers, has often been quoted, and whatever may have been the result of certain other measures taken in that island for the encouragement of sugar cultivation, there is no doubt that this or some modification thereof, would afford a great stimulus in India. It is necessary however, to make absolutely certain that the new canes are in every way suitable, and are not liable to ruinous damage from local pests or diseases. It is probable, for instance, that damage from pig would be a serious matter in the United Provinces and Bihar, if thick cane were introduced, and it would be difficult to arrange for effective protection of the small scattered areas.

North-West Frontier Province.

Although situated in the extreme north-west corner of India and exposed to bitter frost in the cold weather, sugarcane is grown in the North-West Frontier Province under irrigation from river channels, on an area of 31,000 acres, and a yield of over two tons of *gur* is obtained from an average crop of 28 tons per acre. The area is said to be limited by the local demand for *gur* and the difficulty experienced by the cultivators in manufacturing it. The Agricultural Department has for some years past conducted experiments with a view of introducing a modern factory system of cultivation and manufacture, and the results indicate that the prospects of success justify the establishment of an experimental Government factory, which could be developed into a large concern drawing its supplies of cane from a maximum area of 5,000 acres. At the same time the prospects of beet sugar cultivation have been investigated with almost equally favourable results, and it is suggested that a central factory, if erected near Nowshera, could obtain supplies of both cane and beet which would enable it to operate for between seven and eight months in the year. This unusually long period is partly due to the fact that the cane after cutting can be preserved with little or no deterioration over a period of several months. At very small cost, therefore, the gap between the end of the cane and the beginning of the beet harvest can be bridged. The beet harvest can also be prolonged by sowing in September and October and again in February and March. No information is available as to the ultimate extent to which developments in the direction of this combined cultivation could be carried, but it is probable that the initial success of one factory would lead to the establishment of others and that the ultimate limit would depend upon the extent of land which could be brought under irrigation. This might possibly be increased by the employment of pumping plants on a large scale.

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* P. Geerligs' World's Cane Sugar Industry, 1912, page 86.

There are in Assam and Burma large areas of land suitable for the cultivation of sugarcane without irrigation; but it is probable that irrigation supplementary to the rainfall will be found to be very profitable, and this can be supplied by the addition of small pumping installations capable of lifting water from the rivers and streams, which in these provinces are of a perennial character. The area under cultivation in Assam in 1917-18 is stated to be 35,000 acres, with an average yield of only 0·9 tons of *gur* per acre. This outturn is recognised to be much less than might be obtained with good cultivation; and, at the instance of the Board of Agriculture, the Local Administration has started experiments at Kamrup with a view to develope cane cultivation on modern lines and to work up the crop in a large central factory to produce white sugar. The experimental work commenced in 1914-15 and has gradually developed, though progress has been delayed by the difficulties in getting machinery for the central factory. Up to date nearly 700 acres of land have been broken up by steam-ploughing tackle, and 530 acres planted with cane. The erection of the manufacturing plant has not kept pace with the agricultural developments, and no commercial results are yet available. The experiment is an exceedingly important one, and, though unforeseen difficulties have been met with, the results so far obtained are very promising, and there is every reason to expect that it will ultimately prove the possibility of establishing in Assam the central factory system of growing cane. **Assam.**

In Burma the area under cane in 1913-14 was 15,100 acres. Here an attempt was made to get a central factory started, but owing to the war the idea had to be given up. The proposal was that a Rangoon firm should undertake to make experiments in the area commanded by the Minbu canal, at a cost of Rs. 20,000, half of which was to be paid by Government. If they proved successful, the firm was to lay down plant capable of dealing with an area of 10,000 acres. It is stated that crops of 30 tons per acre without manure have been obtained on the Government farm. **Burma.**

It seems that promising tracts exist in these two provinces, for the establishment of central factories, growing at any rate a large proportion of their own cane, but that there are many initial difficulties to overcome, especially in the matter of labour. Areas taken up for cane growing would presumably be free from tenancy rights and other incidents of our Indian revenue system. It is especially this freedom from legal difficulties that inspires a hope that a really considerable quantity of sugar might ultimately be produced in Burma and Assam. Dr. Barber, who has visited the former province, regards the conditions there, apart from labour difficulties, as very promising, and it should be the policy of Government to give out suitable areas for the establishment of central factories to reputable firms, and to invite such applications. The system followed should provide for small cultivators growing cane alongside the larger areas of the factories, a condition which the probable necessity of importing labour renders the more important.

General.

In accordance with the recommendations of the meeting of the Board of Agriculture held in 1911, Dr. Barber has been engaged on the production of seedlings suitable for various conditions of soil and climate, and also seedlings with maximum sucrose content. Very promising results have been reached in this latter direction as the result of two seasons' work. An agricultural question of importance to the factory owner is the extension of the period during which cane can be obtained ready for crushing, by selecting varieties that ripen at different times, or by extending the period of planting so as to prolong the ripening period. If, as stated in the note prepared by Mr. Coventry on cane growing in Bihar and printed in the Report of 1916 (page 90) of the Board of Agriculture, early planting does not lead to early ripening, this may be owing to the cold of the early winter months, as in the warmer climate of the south of the Central Provinces, the opposite was found to be the case. Two different classes of cane, one early and one late ripening, could, however, as Mr. Coventry stated, be grown in Bihar side by side, thereby extending the period.

Manure.

4. In view of the shortage of farmyard manure, it is necessary to employ some substitute which can replace farmyard manure wholly or partially. This exists in the form of various kinds of oil cake, which, at any rate in the case of heavily manured and well cultivated land in Bombay, gave the most economical results when used with ammonium sulphate. The stimulation of the oil-pressing industry that would arise from an increased demand for cake would be a desirable end. Sulphate of ammonia was sold in India before the war (June 1913) at Rs. 257 per ton; it should be possible to sell sulphate of ammonia produced in India at a much lower price than the imported article.

Cost of cultivation and availability of cane.

5. The cost of cane cultivation and the prices paid for cane by factories are of interest in this connection. The usual price paid for the poor class of cane obtained by factories in the United Provinces and Bihar before the war was four annas a maund. The price however varied between 3½ and 6 annas, according to the price of *gur* and competition between factories. Higher prices were said by the Bihar witnesses to have been paid since the war, but generally the price in Bihar is much the same as in the United Provinces. In places where a thicker class of cane is grown, much higher prices are the rule, although, except in Madras in the neighbourhood of the sugar factory at Nellikuppam, there is very little purchase of cane on a commercial basis in such tracts. The ryot in Madras and Mysore takes his cane to the power-driven mill and gets it crushed and the juice boiled down to *gur*. For this he pays the charges levied by the owners of the mill, and then he sells the *gur* himself, obtaining a price equal to 10 to 12 annas per maund of cane. The lowest price in pre-war times was eight annas a maund. Enquiry in connection with experiments in the Hadi process in the Central Provinces showed that nine annas a maund was the lowest figure that would satisfy the cultivators. In Bombay, it cost the Agricultural Department slightly over four annas to grow a maund of cane in 1915-16. Most Bombay and Madras canes have a much higher percentage of extraction and usually of sucrose than the northern canes, but not, it would seem, enough to account for the great difference in price. Canes which are doubtless somewhat of the same class as those grown in Bombay

and Madras are grown in Fiji and Mauritius. In Fiji the nett cost to the factory is three annas a maund, including the expense of planting, cutting and transporting, which is borne by the factory. In Mauritius, the Indian growers get 5·3 annas a maund. The Formosan grower receives on an average 4½ annas a maund for a cane with 11 per cent. sucrose contents. This approximates fairly closely to United Provinces conditions. Until the Bombay grower is ready to sell his cane at a price which may be provisionally stated at six annas a maund or a little more, on a pre-war sugar price basis, it does not look as if a central factory would have much chance of success in that Presidency. Efforts have been made in the United Provinces to induce the ryots to sell their cane on a basis of extraction, but without success. If improvement were taken up on a large scale, the growers of better cane would doubtless be ready to sell on a basis of extraction results; and if so, the growing of inferior types would no doubt tend to decrease more rapidly.

In the southern provinces, on the other hand, the problem would seem to be one of increasing the area under cane until the market for *gur* is overdone. If the yield is so large as to make the growing of cane still profitable on a lower price basis for *gur*, and therefore for cane, an opening for the central factory will at once be created. If, however, a fall in the price of cane to a point still above what a central factory can afford to pay, leads to a decline in area, the future prospects of sugar making in these tracts are not promising. Here the Agricultural Department can be of assistance, by showing the cultivator how to grow as much cane per acre as possible in the most economical way. Another difficulty, however, which must be faced, is that due to the small area of cane in any given tract, and efforts will have to be made to bring about a greater concentration in favourable situations, so as to diminish as much as possible the cost of transport to a central mill.

Agricultural improvement future work.

6. It would seem, then, that there is a possibility within the next few years (1) in the southern provinces of a considerable increase in the area under the irrigation works combined with some increase in outturn, (2) in the northern provinces, if the policy laid down by the Board of Agriculture is vigorously pursued, of a very large increase in the outturn of the existing area, and possibly of an extension of that area in consequence of the more profitable nature of the crop. This is so much larger than all the southern areas together, that no effort should be spared to promote improvements on lines already ascertained to be suitable. In particular, the establishment of a sugarcane farm in the part of Bihar north of the Ganges should be no longer delayed. In this tract we found the main sugarcane areas and practically all the factories of the province, and it adjoins a part of the United Provinces where much cane is grown. The establishment of central cane factories (3) in Assam and Burma offers promising prospects.

There seems no reason why the various increases above indicated should not yield *gur* or sugar, equal or more than equal to the quantity of sugar at present imported.

Limitation of area due to prices of other crops.

7. There is, however, another very important factor which affects the area under cane—*viz.*, the price of other crops. This is especially marked in the case of jute in Bengal.

The cane areas in Bengal (including Assam) and in the United Provinces in the year 1890-91 were 1,146,611 acres, and 1,104,334 acres respectively (Agricultural Statistics figures). In the year 1907-08 they were 616,032 acres and 1,471,831 acres, although the yield in Bengal is certainly higher than in the United Provinces. One reason for the decline in the case of Bengal may be seen from the statement below:—

Period.		Price of jute, per bale, Calcutta.			Total area under jute (India) acres.	Price per maund Valley *gur*, Calcutta.			(Final forecast) Area under cane (Bengal).
		R	a.	p.	*	R	a.	p.	Acres.
Average of 5 years ending	1904-05	33	8	11	2,530,308	3	14	9*	680,380
Year	1905-06	57	8	0	3,140,822	4	8	3	623,100†
	1906-07	50	11	8	3,523,558	4	3	2	606,700†
	1907-08	39	1	5	3,942,675	4	3	5	607,200†
	1908-09	32	9	4	2,835,454	6	3	9	553,000†
	1909-10	36	10	8	2,756,820	6	12	2	507,800†
	1910-11	40	9	8	2,828,669	6	2	0	515,600†
	1911-12	54	4	0	3,090,827	4	12	0	521,000†

* Average for 3 years only.

† Including Assam.

Gur fell even lower in the next two years; but during the above period the price of *gur* rose 18 per cent. and that of jute 61 per cent. The area under cane declined by 23 per cent. and that under jute rose by 22 per cent.

Demands for *gur*.

8. It is difficult to draw definite conclusions from such statistics as are available regarding either the production of *gur* or the prices realised in free markets. *Gur*, as ordinarily made, does not keep well in damp weather, and immediately after the cane harvest season the crop is thrown on the market, owing to the inability of the ryots to hold it for any length of time. Consequently there are violent fluctuations in price, and the bulk of the crop has to be sold at the time when prices are lowest. Average rates, therefore, are totally misleading as regards the actual cash returns received by the growers.

There is no reliable evidence of a decreased demand for *gur*, as the percentage of the Indian cane crop which is made into sugar is still small, and the figures show that, if anything, there has been in recent years an increase in the area under cane, which is likely to become of greater importance now that the price of imported sugar has risen.

The rapid increase in the imports of sugar is, therefore, due to the increased demands of the people for saccharine matter, consequent upon a rise in the standard of living, and it is an open question whether the anticipated increase in the production of sugarcane in India will be used in the form of *gur* or manufactured sugar. If the demand is for *gur*, the prices for that product will remain high, and it will be difficult for factories producing sugar to obtain supplies of raw material. On the other hand, if the demand is for sugar, the present ratio of prices between *gur* and sugar will not be maintained, *gur* will become cheaper and the sugar refineries will be able to purchase it. Hitherto, sugar has been the only article of food which, to any considerable extent, has been imported into India, and the cane grower and therefore the *gur* producer have been subject to competition from an overstocked market which was artificially supported by bounties and cartels. While world prices for food grains and fibres capable of being grown on land suitable for sugar have risen, the prices for sugar have steadily fallen, and consequently the Indian sugar grower has found his cultivation less profitable. His methods of cultivation have remained unchanged, but to some extent his returns have been increased by the use of iron sugar mills. Recent work by the Departments of Agriculture and of Industries in some provinces has, however, demonstrated definitely that there is scope for great advances in the yield of cane by better cultivation and in the extraction of its sugar contents by the use of power-driven milling machinery. The adoption of these new methods and appliances will increase the returns per acre without increasing the cost of production in a similar ratio, and, the margin of profit being thus extended, the area under cultivation will grow till the returns cease to offer inducements for any further expansion.

Economic limits of central factories.

9. No reliable information is at present available regarding the economic limitations of the central factory system in India. There is both an upper and a lower limit, but the former need not concern us as it is never likely to be reached in India. The lower limit depends on the degree of efficiency in manufacture which can be obtained when working on a small scale, and on this point the experiments in progress in the United Provinces have not yielded any satisfactory data. That the efficiency will be less than would be obtained with larger plant is certain, but the loss on this account may be counterbalanced by the diminished cost of transport, when the cane supplies have to be carried only a short distance and there is a local market for the whole outturn. The cost of management is also a factor of some importance, and small Indian central factories should be able in this respect to hold their own against the somewhat expensive control of the larger factories. At the present time the lower limit of the factory system seems to be a mill capable of dealing with 250 tons of cane per day, or with the produce of an area of 25 acres in the north of India or of 10 to 12 acres in the south. Assuming a working season of 100 days, the smallest central mill will require 2,500 acres of cane in the north of India and from 1,000 to 1,200 in the south. Only in a few places can such large areas be secured, and it is urgently necessary to encourage concentration of cane growing as much as possible, simultaneously with the technical development of sugar manufacture on a small scale.

Working of Indian sugar factories.

10. There were in 1915, 23 sugar factories in British India employing 50 or more persons, and three in Native States. Of the above, nine were in the United Provinces, seven in Bihar and Orissa and five in Madras. Some obtained their sugar from *gur* only and not from cane directly, some worked only on cane, and others on both. Some of these factories also worked as distilleries; and in one or two cases they turned to account the carbonic acid gas from the fermentation vats by compressing it in steel cylinders for the use of manufacturers of ærated waters. One factory has carried the sugar industry to the stage of producing sweets.

The limited commercial success attained by sugar factories and refineries in India until somewhat recently, was largely due to imperfect appreciation of the conditions under which the industry must be carried on in India, and to bounty-fed competition from abroad. At the present time the price at which sugar is landed in India is not the only factor in determining whether a season's work will result in a profit or a loss; this depends to a large extent on the current prices of *gur*, which often bear no relation to those of sugar. If the season is poor, *gur* is dear, and unless sugar is also dear, the mills cannot make a profit. But war conditions have, for the time being at any rate, enabled sugar factories to work at a considerable profit.

Obviously the greatest help for existing, and the greatest security for projected mills is a plentiful supply of suitable cane. If this is not available, nothing short of very high protection will have much effect.

Difficulties from point of view of central factory.

11. It must be understood that the peculiar conditions under which cane is grown in India present certain special difficulties, from the point of view of the central factory. As in many other countries, cane cannot be grown in India to advantage continuously in the same plot, except where it is ratooned; it has to be rotated, preferably on at least a three years' system, with other crops; and the areas in which it is grown are very small and scattered. It is, however, sometimes grown by a number of small cultivators in one block, fed either by tanks or canals. In the latter case, rates and water supply are often regulated so as to concentrate cane in blocks, in order to economise water. In Bihar and the United Provinces in particular, holdings are very small, and where cane is grown without irrigation, or from wells, the result is a number of very small isolated patches. In tracts which are subject to the ravages of wild animals, an additional inducement to concentration is found in the facilities given thereby for watching and fencing the crop.

The tenancy law in most parts of India renders it impossible for a capitalist to acquire continuous areas for factory cultivation, and it is more than doubtful if Government would be justified in permitting the compulsory acquisition of these, or if it would be practicable for a factory to acquire such by private negotiation, supposing that a clear title could be passed. The number of cultivators to be expropriated would be very large in proportion to the industrial results; and the process would have to be repeated every time a new factory was started. It would be almost impossible to provide other land for the expropriated cultivators, and much hardship and discontent would be created.

Difficulties retarding expansion of cane growing.

12. Another factor that has to be taken into account is the lack of available bullock power for crushing cane. It will be remembered that by far the greater proportion of Indian cane is made into *gur*, the cane being crushed in bullock mills and the juice boiled by the cultivator himself. As a rule, the cattle power is insufficient to deal economically with the cane grown. The cattle are overworked and weakened by the hard toil of the mill, following on the continuous ploughing of the monsoon and the *rabi* sowings. The temptation to the cultivator to slack off the mill, with much resultant loss in extraction, is great. Again the crushing season is often prolonged till the canes have deteriorated. One or more of these conditions are usually to be found in all areas where cane is grown to any considerable extent. It is manifest, therefore, that the expansion of cane growing, in the absence of a central factory, will be held up, unless some suitable means of crushing cane otherwise than by bullock power can be devised. The replacement of cattle by mechanical power plant, however, will further accentuate the shortage of farmyard manure, to which we have already alluded, and render the necessity of artificial manures more urgent.

The original form of cane mill in India was the old stone pestle and mortar, revolved by bullock power, with an extraction of about 33 per cent. in its most primitive form. This type has now almost disappeared. The mill with wooden rollers was an improvement on it, but worked very heavily, with much strain on the bullocks; it gave an extraction of about 50 per cent. Various types of iron mill have now for the most part superseded both, and these are sometimes purchased by the cultivator, but are also often hired out by firms, especially in northern India and Bengal, at so much a day, the cultivator finding the bullocks and labour.

Efficiency of bullock-driven mills.

13. The highest extraction that can be effected by the best type of bullock-driven mill is about 68 per cent., or in the case of one or two types 70 per cent. This high rate can only be got from thick cane, and can only be maintained

by the use of good bullocks regularly relieved. Under similar conditions, about 62 per cent. might be obtained from medium-sized canes, such as the *sarathi* grown in the United Provinces. From 50 to 60 per cent. extraction is effected by the less efficient types of mill, according to the class of cane crushed, the number of rollers and their setting. A two-roller mill gives about 56 per cent. under the most favourable conditions; but it must be remembered, first, that a cultivator has by no means always enough cattle to work his mill up to its highest extraction capacity, and is often tempted to slack the setting of his rollers to enable the mill to work faster. The result is that he burns under his evaporating pans one-third of the sugar he produces, to turn the other two-thirds into *gur*. In the next place, the rollers are not usually of hardened metal, and get worn more in the middle than at the ends. This also causes much waste of juice.

Small power plants to crush cane for *gur* making.

14. The real remedy is obviously to introduce power-crushing plant of sizes suitable to the cane area available and to the purchasing power and technical skill of the people. The success of such mills, in the comparatively few instances in which they have been tried, has resulted in a tendency to concentrate cane growing in their neighbourhood.

There is a very great difference between the rate of working of power and bullock mills. The results of comparative trials at Poona showed that a three-roller mill, with rollers 20″ × 14″, driven by an oil engine, could crush 4,500 lbs. of cane an hour, against 750 lbs. with a four-bullock mill, and 450 lbs. with a two-bullock mill. Experiments in the south of India with three-roller mills of horizontal type, with rollers 12 inches in diameter and 18 inches in length, driven by oil or gas engines, have conclusively shown that they can on an average extract 15 per cent. more juice from the cane than is usual with bullock mills. Such mills require about six b. h. p. to drive them; they can deal with from a ton to a ton and a half of cane per hour, and extract sufficient juice to yield from 200 to 250 pounds of *gur* per hour. Under favourable conditions, the output of such mills will rise to 300 pounds of *gur* per hour. Roughly, their rate of outturn is equal to that of six pairs of cattle working six bullock mills. As they can be driven almost continuously day and night through the working season, these power plants will do as much work as 24 to 30 pairs of bullocks, and bullocks can only be worked from five to six hours a day each without causing undue deterioration. Evidence is forthcoming to show that such power-driven mills can economically replace cattle for areas as small as 40 or 50 acres, and that even smaller types of power-driven mills can be advantageously employed for areas as low perhaps as 25 acres.

Where these small power-driven mills have been introduced, it has been definitely established that they have increased the value of the product from a given area of land by from 25 to 30 per cent. Part of this is due to the fact that the increased milling power enables the crop to be handled at exactly the time when the sucrose contents are greatest.

In Mysore such plants have been installed by sugarcane growers cultivating large areas; others have been installed at State expense in places where the concentration of cane growing justified the experiment; and more recently several have been established by co-operative societies which have been largely financed by State loans. No evidence has been produced to show that any one of these plants has been completely successful in regard to the important matter of continuous working during the season; but, year by year, it is claimed that the results are improving and that the ryots in the neighbourhood are beginning to rely more and more upon them.

The remarks below indicate the experience which has been gained in Mysore.

"There is as yet but little evidence to indicate the best way to encourage the development of these power plants. Most of the large growers of sugarcane have already adopted them. The ideal method is to form co-operative societies amongst the growers of the cane who will employ qualified experts to run the plants. In those instances in which small capitalists have taken over factories originally started by Government, there seems to have been a considerable amount of friction which has been injurious to both parties. Although a very considerable measure of success has been achieved, a great deal yet remains to be done to determine the nature of the organisation which should be encouraged to carry on and develope this method of preparing *gur* for the market. But an infinitesimal portion of the Indian sugar crop is so far dealt with in these small mills; yet the results obtained justify further work on a greatly extended scale."

It seems proved, then, that if the area under cane is to be increased, if heavy crops are to be grown, and if the present tremendous waste of juice is to be avoided, small power plants will have to be introduced in very large numbers. The preliminary demonstration work must be undertaken by Government. Progress has been hitherto very slow, except in Madras and Mysore. Every use possible should be made of *takavi*, of co-operative finance, and of the assistance of landlords, but it seems that, for some time to come, the most promising policy would be to encourage small capitalists to crush for local custom.

Improvements in *gur* manufacture and its effect on refineries.

15. The subsequent disposal of the juice is the next point for consideration.

The three main directions in which improvement of the *gur*-making process is being attempted are—(1) economy of fuel, (2) production of a better quality of *gur*, (3) avoidance of waste from burning and skimming. As regards the first point, there is no doubt that over quite considerable tracts, the cultivators find it possible to boil the *gur* without other fuel than the megass and trash. The Poona furnace has been for long demonstrated in various parts of India, and is an improvement on most local methods. Concurrently with the experimental work involved in replacing cattle power by oil engines or gas engines, efforts have been made in Madras to improve the arrangements for boiling down the juice, and, while finality in this direction has perhaps not been reached, great improvements have been effected by the introduction of a properly constructed megass-burning furnace, the hot gases from which pass under a series of pans. The price of *gur* varies a good deal according to quality; but the best qualities do not in all cases suit local tastes. There is, however, no reason why, with instruction, the ryot should not produce a very much better type of *gur* than at present. The soft, dirty *gur* of Bihar and the eastern districts of the United Provinces sells for only Rs. 4 per maund, while cleaner *gur* from the northern districts fetches Rs. 5. The former is mainly in demand for refining, and the production of a better *gur* in Bihar and the eastern United Provinces districts, with a consequent rise in prices, would also probably be fatal to the refining industry in the north. This would scarcely be a matter for regret, inasmuch as the cultivator turns out *gur* which fetches a far lower price from the refiner than he could get for a better made article from the ordinary consumer, while the refiner, by dealing with a sugar product which has already passed through a process which renders it less suitable for sugar manufacture than the juice from which it is made, wastes a proportion of the sugar available in the cane.

The amount of sugar obtained from *gur* refining is about 4·4 to 6 per cent. against 7 to 8 per cent. obtained by direct sugar manufacture from the cane. On the other hand, the decay of the refining industry has led to a rise in the price of molasses from Re. 0-9-6 a maund to three times that price, thereby affording a market for Java molasses, at one time a waste product, whilst at the same time enabling Java sugar to compete in India on more favourable terms.

The two main advantages to the large factory refining *gur*, as compared with the direct process of sugar manufacture are—(1) that the work can go on continuously throughout the year, and (2) the heavy capital outlay and recurring cost of crushing and concentration are avoided. The process as at present carried on, both as a sole industry and by cane-crushing factories in order to extend their working season, is not likely to die out for a long time, but it does not seem desirable to take any special steps to assist it.

Summary of proposals.

16. In this note proposals relating to agricultural improvement have been given the greatest prominence. They are generally as follows:—

The present improvement of cane should be encouraged in the southern provinces. In the United Provinces, a very special effort should be made by demonstrations, by grants of *takavi* loans, or by any suitable modification of the Formosa system, described in paragraph 3, to induce the people to take up the growing of superior canes and to manure them as heavily as the local factors of limitation will permit. A no less insistent campaign should be waged in favour of the small power mill. *Takavi*, co-operation, hire-purchase, and any other suitable system should be employed. Care should be taken to see that the machines are inspected often enough to keep them in good running order, and that *mistris* are made available for running them. Finally, in new areas like Burma and Assam, where agricultural conditions are naturally favourable, and the encumbrances of tenancy and other rights do not exist, every effort should be made by fair offers to induce concessionaires to come forward and build up a cane industry on modern lines. It seems probable that from these areas alone India may be able to obtain a very large proportion of the cane sugar that she now imports.

The above measures would undoubtedly lead to or render possible the establishment of more sugar factories, and, so far as European-managed factories are concerned, little more in the way of help is needed. For the benefit of small factories which cannot afford European supervision, however, separate expert advisers should be available for the United Provinces and for Bihar and Orissa. The propaganda of small power mills should not be in their hands; it can be carried out as well by a less highly paid specialist with a proper staff. The sugar expert's services should be given freely and fully to the smaller capitalist, especially at the start of his operations. For the conduct of his work, he should be enabled to experiment freely and under suitable conditions. He should have a small factory under his charge for this purpose and to train foremen for the use of the factories in his province.

APPENDIX D.

THE DEVELOPMENT OF THE INDIAN TANNING TRADE.

Extent of Indian trade in hides and skins (raw and tanned).

It has been calculated that in India there are about 180 million cattle and 87 million sheep and goats. Though it is only possible to form an approximate estimate of the total number of hides and skins which become available, there is very detailed information regarding the nature and value of such portion of the supply as is exported, either raw or in the form of leather, partly or completely manufactured. The value of the exports in the last four years extracted from the sea-borne trade returns is given below:—

Year.	Value of raw hides and skins exported. Lakhs.	Value of leather and tanned hide and skins exported. Lakhs.	Total. Lakhs.
1914-15	7,82	4,76	12,58
1915-16	9,79	5,64	15,43
1916-17	14,41	9,44	23,85
1917-18	7,84	6,37	14,21*

* Provisional figures.

Except to those engaged in the trade, the voluminous figures contained in the statistical returns are of little interest; the history of the foreign trade is largely a record of the results of fiscal regulations. The United Kingdom has always taken the bulk of the tanned or dressed hides and a very large proportion of the tanned or dressed skins, while the raw material has gone to those countries which protected their manufacturers by the imposition of heavy duties on all but raw products. Till the war broke out, Germany, Austria, and Italy were the principal destinations to which raw hides were sent, and roughly three-fourths of the raw skins were purchased by the United States. Very little information is available regarding the internal consumption of hides and skins. Probably half the hides and nine-tenths of the skins available in the country are exported.

Effects of increasing value of raw materials.

2. Hides and skins may be regarded as a by-product of agriculture, the supply to the market being but little affected either one way or the other by the demand. The export trade, nevertheless, has, from the beginning, steadily expanded both in volume and value, and even more rapidly in value than in volume. Indian raw material fills an exceedingly important place in the leather markets of the world. Prices have constantly tended to rise, and important changes have thereby been brought about in respect of the internal consumption of leather. These will be discussed later on.

A return of the exports by sea from Fort St. George for the year 1846-47 shows that 48,212 hides valued at Rs. 22,423 were exported to the United Kingdom, the average value of each hide being Re. 0-7-5, whilst in 1912-13 the sea-borne trade returns show that 13,450,913 raw hides were exported from India valued at Rs. 8,05,86,105, or an average of Rs. 6 each. Similarly, raw skins in 1846-47 were worth Re. 0-3-2 each and in 1913-14 Re. 1-9-6.

This increase in the value of the raw material has naturally affected rural economy to some extent by stimulating the improvement of the organisation for collecting hides and skins. Formerly, they were the perquisite of the village *chuckler* or *chamar*, who tanned them in a primitive way and supplied the needs of the villagers in the matter of leather. The increased value of the hides and the ease with which they can be marketed have led the *chuckler*, in many places, to abandon the tanning business and to sell the hides to dealers for cash. It has also led the villager to dispute the *chuckler's* right to the hides and to employ him instead as an intermediary in the disposal of them; while he now purchases leather in the open market from the agents or middlemen of the organised tanneries and hands it over to a *chuckler* to make up into whatever he needs.

Peculiarities of Indian hides.

3. Indian hides differ a good deal in size according to locality and breed; speaking generally, the larger hides come from the Punjab, the north of the United Provinces, and parts of Bombay and Madras. The inferiority of Indian hides is only partly due to the poor quality of the cattle. Branding depreciates their value enormously and, as many of the cattle are used for draught work, their hides show signs of wear and tear. Only in the large towns, and more especially in the cantonments, are cattle killed for food, and the bulk of the hides available are those taken off animals which have died from disease, old age, or injury. "Slaughter-house" is an elastic term and is often applied to hides of good quality taken from animals that have died from natural causes, but strictly it is only applicable to those obtained from cattle which have been fattened up for killing. Slaughter-house hides proper are usually of good quality and, in the case of cow hides, might well be used for making sole leather; but their number is small. Hindus are very averse from killing animals, and they allow their cattle to linger on in sickness and old age. The animals suffer and naturally their hides deteriorate, but the most fruitful source of injury is the merciless way in which cattle are branded. This is carried on to such an extreme that many thousands of hides are absolutely ruined, and large numbers of them are depreciated fifty per cent in value through branding, which is done to satisfy the owner's æsthetic eye or calm his troubled mind. It is supposed to be efficacious in keeping away evil spirits and preventing disease, and it is also largely practised as a remedy for many diseases, especially in the nature of staggers or fits.

The prejudice against killing cattle is, however, disregarded in some parts of the country. In the Central Provinces and the United Provinces, "jerked" meat for export to Burma is prepared on a large scale, and there are a number of slaughter-houses at Agra, Damoh, Rahatgarh, Khurai, and other places, where thousands of cattle are slaughtered every day, and a trade not very dissimilar from that of the meat packers of Chicago is carried on. These establishments furnish large numbers of hides of a quality somewhat superior to those taken from the animals that die from natural causes, though the animals sent there for slaughter are usually past work.

Indian skins.

4. The term 'skins' is technically applied only to pelts of sheep and goats. Goat skins are larger, heavier, and of much better texture than sheep skins. Unlike hides, the majority of skins are derived from animals which have been slaughtered for food, and the pelts are, therefore, in a much better condition and will compare favourably with similar classes of skins from other parts of the world. The tanning of skins is practically confined to Bombay and Madras, and the bulk of the business is done in the latter Presidency, the tanners of which supplement the local supplies by importing largely from other parts of India. The quality of skins varies very much with the season of the year; but, unlike hides, they are generally at their worst during

the rainy season when the animals become feverish through exposure, and the effect shows in the pelts. The hair or wool grows longer on account of the cold, and this leads to loss of tissue, with the result that the pelt is thin and papery. The majority of the dried skins are exported to be chrome tanned in America or Europe and converted into glacé kid. Skins tanned by the chrome process do not gain substance like those prepared by vegetable tanning, and plump well-nurtured skins are, therefore, in great demand by chrome tanners. Anything less than a spread of 75 square feet per dozen skins is regarded as unsatisfactory. Moreover, every skin should be at least 21 inches wide, so that when converted into glacé kid, it may be possible to cut two sets of upper sides from each skin.

Establishment of western methods of tanning in India.

5. It is difficult to obtain information regarding the tanning of leather in India before the industry came under the influence of western methods. Judging by what is now done in remote districts, where the village tanner is still uninfluenced by modern methods of procedure, it is probable that the indigenous industry was in an extremely primitive condition and that only very inferior kinds of leather were produced. Tanneries of considerable size must have existed to supply the harness and saddlery for the enormous numbers of troops and retainers who were kept under arms by the numerous rajas, zemindars, and petty chieftains, who formerly exercised more or less independent sovereign powers throughout the country. The requirements of the town population were probably small and confined chiefly to sandals and vessels for holding oil and ghee; but the ryots used large quantities of village-tanned leather for water bags, for leather thongs, and for ropes.

European methods of tanning hides were first introduced by the military authorities to manufacture superior leather suitable for harness and other military accoutrements. Contemporaneously in the early forties of last century, a French Eurasian of Pondicherry, named D'Souza, introduced improvements in the native methods of preparing skins. He is said to have visited the island of Mauritius and to have there acquired a practical knowledge of the French processes of tanning and, on his return to Pondicherry, he started a tannery and, a little later, came to Madras and set up several small tanneries in the neighbourhood of that city, the products of which were probably exported to England. Of his improvements the most important was the immersion of the tanned skins in a bath of myrabolams after the ordinary tanning had been completed. This prevents a very objectionable change in colour which otherwise takes place on the exposure to sunlight of leather or skins tanned with *avaram* bark. There is no clear evidence that from his time till the advent of chrome tanning any further changes in the methods of tanning skins have been introduced into India. The small demand for highly finished skins in India was met by importation from Europe, and the somewhat crudely prepared Indian-dressed skins were welcomed by the tanners in Europe as the raw material from which to prepare the very best classes of light leather.

Growth of modern tanning industry.

6. The developments of leather manufacture in contradistinction to the light tannages of Madras and Bombay are almost entirely the outcome of military efforts to obtain suitable supplies for boots and accoutrements. Where arsenals were established, tanneries usually followed. At Cawnpore, the Government Harness and Saddlery Factory was started in 1860 on an experimental scale and, as it proved a success, it was placed on a permanent basis in 1867. Shortly afterwards, Messrs. Cooper and Allen started the Government Boot and Army Equipment Factory and, at the outset, they received a considerable amount of financial assistance from Government. A marked

degree of success has attended the efforts to develope the leather trade in Cawnpore, and, up till the time of the outbreak of war, the factories which have come into existence, though largely dependent on the army for orders, were by no means appanages to the military department.

The successful establishment of the industry on a large scale is due to the following facts:—(1) Cawnpore is a convenient centre for the collection of hides from Northern India; (2) at the outset, there were large supplies of cheap *babul* bark, an excellent tanning material; (3) the business was in the hands of enterprising Europeans; and (4) their efforts were viewed with favour, and largely assisted by Government, who provided a market in the early days for the bulk of the outturn. Working on similar lines, but on a much smaller scale, an enterprising Khoja Muhammadan, Adamjee Peerbhoy, established at Sion, in Bombay, the Western India Army Boot and Equipment Factory. In Europe and America machinery is very largely employed in tanneries and leather-working factories but, although it has been employed on a considerable scale in the Cawnpore and Sion factories, elsewhere, till quite recently, it was conspicuous by its absence in the Indian tanneries, which produced the whole of the half-tanned leather and skins, that bulk largely in the export trade of the country.

Chrome tanning in India.

7. The action of various chemicals on hide substance has been the subject of scientific investigation for many years past and, about 1895, the method of producing leather by means of chromium salts was thoroughly established in America on a commercial basis. The process was also taken up on the Continent and, somewhat more slowly and at a rather later date, by English tanners. Some experiments were made in India both in Cawnpore and Madras; but they resulted in nothing practical till, in 1903, the proposal was made in Madras to use leather prepared by this process for water bags for the country *mhots*. The experiments proved successful and resulted in the establishment of a Government factory, in which chrome leather was manufactured on a considerable scale and applied to a variety of purposes in place of bark-tanned leather. The history of this factory will be found in Appendix J. That it was prematurely closed there seems to be no doubt, as the progress of chrome tanning in India has been much slower than it is reasonable to anticipate would have been the case had Government assistance in pioneering the industry been given for a longer period. The developments have followed the line of least resistance, and, in the hands of private individuals, immediate profit has naturally been of greater importance than ultimate development. Of the chrome tanneries which were started, seven or eight have survived the initial difficulties and are now mainly employed on the manufacture of leather for sandals and boots and shoes. The manufacture of black and brown box sides has been developed on a considerable scale, and this completely finished leather has found a profitable market in Great Britain.

At the outset, it was thought that there would be a very large market for chrome leather for water bags, but progress in this direction has been comparatively slow. The rise in the price of leather has led the ryots to use light iron buckets, and competition with them left comparatively little profit to the chrome tanner. The Madras Tannery was the first in the south of India to introduce the use of machinery in the tanning processes, and the success with which such machinery has been working has led to its adoption to some extent in bark tanneries. This latter development is a matter of some importance, as it has engendered a more progressive attitude amongst the Indian tanners.

Efforts of the Munitions Board to stimulate manufacture of leather articles.

8. Evidence of this is visible in the success which has attended the efforts of the Indian Munitions Board to stimulate the manufacture in India of certain classes of leather goods previously imported from abroad. The scrutiny of applications for priority drew attention to the possible market for locally manufactured roller skins, picker bands, leather belting, and raw hide pickers. Early in June 1917 the Board accordingly informed Indian firms that if they could satisfy it, by production of suitable samples, that these articles could be made in India, priority applications for import from abroad would be refused. A number of the more recently established tanneries of the improved type took the matter up with most encouraging results and, with regard to roller skins and picker bands, it is understood that they have no difficulty in disposing of their outturn. The manufacture of leather belting and of raw hide pickers proved a matter of greater difficulty, and experiments are still in progress. Excellent belting has been made from specially selected hides, but the general average is not yet up to the required standard. In regard to pickers, the large sizes used on jute looms are working satisfactorily, but the smaller pickers for cotton looms still leave much to be desired.

Effects of the war on the tanning and leather trades.

9. The position of the leather trade in India at the present time may now be summed up briefly. The highest developments of manufacture at the outbreak of war were to be found in factories most intimately associated with the supply of material for military purposes and in the smaller tanneries devoted to the production of chrome leather. The bulk of the leather made in the country was either for internal consumption and of inferior quality or for export as half-tanned leather, to which the trade applied the term 'East India Kips'. Practically, the export trade was confined to Madras and Bombay, and was chiefly to Great Britain and, to a much smaller extent, to the United States of America and to Japan.

Some time after the outbreak of war, the value of the 'East India Kips' as upper leather for army boots was realised in England, and efforts were made to increase and regulate the supply. From August 1916 the Indian Government, at the request of the War Office, assumed complete control of the trade and took over from the tanners the whole of their output. The arrangements made by the Commerce and Industry Department were transferred to the Indian Munitions Board, after its creation in March 1917. In pre-war years, the exports were below 200,000 cwt., of a value of less than two crores of rupees. In the year 1917-18 they reached 360,000 cwt., of a value approaching five crores of rupees. Roughly, in four years, the output of the Indian tanneries for this class of leather only has been doubled. The control of the trade has enabled some minor, but very important, improvements to be effected, the chief of which are the prevention of adulteration and the elimination of faulty flaying. This great development of hide tanning has been accomplished in the face of grave difficulties due to inelasticity in the supplies of tanning bark, and it has been necessary to take action in several directions to maintain the output of tanned hides. The Indian export trade in tanned hides and tanned skins was confined to the south of India where the bark of Cassia auriculata, known in Madras as *avaram* and in Bombay as *tarwad,* is obtainable. Elsewhere, the cost of railway freight makes tanning with this bark commercially unprofitable. The increased demand for tanning materials has led to a great rise in prices and has more than doubled the cost of tanning. The attention of Local Governments has, therefore, been directed to the urgent necessity for measures to increase the supplies of *avaram* bark, either by more careful collection or by cultivation on an extensive scale. To meet the increasingly urgent demands of the military authorities for more leather, it became necessary to prohibit the tanning of skins, which not only rendered available for hide tanning the bark previously used for skin tanning, but led to many of the skin tanners taking up hide tanning instead. These measures have produced immediate results; but attention is also being directed to the provision of substitutes for *avaram* bark. To this end, the Indian Munitions Board has entered into an arrangement with the Esociet Company at Maihar in Central India, whereby it has taken over the experimental tannery and the staff employed on research work, and it has purchased a tannery in Allahabad with a view to ascertaining the commercial value of the conclusions reached in the research factory. Promising results have already been obtained from a variety of mixtures of Northern and Central India tan-stuffs and it is anticipated that, ultimately, it will be possible to provide tanning material of as good a quality as *avaram* bark for a great extension of tanning in Northern and Central India. As will be seen in the sequel, the success of these efforts to develope fresh supplies of tanning materials will greatly strengthen India's position in the leather trade after the war.

Possibilities of expansion of tanning in India.

10. The problem of the future is how to obtain for India a larger share in the work of preparing her abundant raw material for the market. The limits of reference preclude any discussion of the tariff question and, though the trade has been, and will continue to be, affected by whatever fiscal policy is adopted, in what follows it is assumed that if sufficiently good finished material be produced, it will be possible to sell it at profitable prices. The steady rise in the value of Indian hides in the years immediately preceding the war may be reasonably accepted as evidence that the demand for the commodity was in excess of the supply, and it may be contended that the contribution to the world's markets which India is able to make is of sufficient importance to enable her to dictate in what form it shall leave the country.

The position is perfectly clear. There is a very large, but limited, supply of Indian hides, which was not sufficient to meet the demands made upon it in pre-war times, and it may be confidently anticipated that these demands will increase after the war, owing to the diminution in the number of cattle in belligerent countries. It seems certain, therefore, that for a long time to come there will be a very serious shortage of hides and leather. From the Indian raw material, by the exercise of skill, experience, and technical knowledge, a valuable leather can be made either on the Continent, in Great Britain, or in India. If it is made in India, by exactly the quantity made will the stock of hides available for export be diminished. For India to obtain advantage from the situation it is necessary to make as good a leather out here from the local hides as can be made from the same hides elsewhere. The production of an inferior quality of leather will involve heavy loss, as it will only fetch a low price in competition with good leather made from similar material. There must, therefore, be no waste in this direction.

It is, therefore, not altogether unreasonable to assume that the future of the Indian leather trade can be usefully discussed without any reference to tariffs, although these will of necessity play an extremely important part in the transition period during which the export trade is being changed from one mainly in raw hides to one of tanned hides or finished leather.

Necessity for expert investigation.

11. While the best Indian raw hides are distinctly inferior to the best produced under more favourable conditions in temperate climates, the Indian goat skins are of high grade and suited for first-class work. But from these skins Indian tanners have not so far been able to produce finished goods of anything like the quality that can be manufactured from them in Europe and

America. In explanation of this, it has been alleged that in India it is too hot to produce first-class work, and there is no doubt whatever that the high temperature of the soaks and lime pits is a disadvantage. Tanning under tropical conditions has never been carefully studied by experts with both a scientific and practical knowledge of the trade. The experimental tannery started by the Department of Industries in Madras was the first practical recognition of the necessity for such work. It is unfortunate that, for reasons arising out of the war, there has been delay in taking up this matter, and it is unquestionably urgent that the obstacles which have hitherto prevailed should be overcome as soon as possible. It may almost be accepted as axiomatic that the development of the Indian leather trade can only be accomplished by bringing to its assistance technically trained men, qualified to deal with the local problems and capable of modifying European and American methods to suit local conditions.

It is obvious that India cannot afford to neglect any of the advantages enjoyed by the tanning trade in other countries, and it may be regarded as essential that adequate provision should be made, as early as possible, for the investigation of tanning methods in India. The Madras experimental factory was a step in the right direction; but it was started on a scale that is now inadequate to meet the more urgent situation which has arisen since it was first proposed.

The experimental work at Maihar under the Indian Munitions Board has already been mentioned and the results obtained so far are sufficiently promising to warrant its continuance with a stronger expert staff. We understand that Maihar was selected by the Indian Munitions Board because important researches had already been started there and the expense of establishing a new laboratory and factory could be avoided, but it will be necessary to consider later the locality most suitable for a permanent research station. If found necessary, these experimental investigations should be transferred to a site better adapted for the wider scope of the work now contemplated. Already, we understand, no little inconvenience has been caused by the distance between the research work at Maihar and the commercial experiments which are in progress at Allahabad. The conditions in India in respect of the supply of raw material, both hides and skins and tan-stuffs, vary considerably, and it is possible that there may be scope for combined research laboratories and experimental tanneries at such centres as Calcutta, Madras, Allahabad, and possibly Bombay. It will also probably be necessary, when the research work has yielded the expected results, to establish Government tanneries elsewhere, in which to demonstrate the value of the new tanning materials and the changes in tanning practice involved in their use. We contemplate that, ultimately, these factories should be handed over to private enterprise, but not while they are found to serve a useful purpose either by way of demonstration or as training centres.

Proposals for training Indian tanners.

12. The question arises as to what provision should be made for the technical instruction of men who will afterwards be in charge of tanneries. Neither experimental nor demonstration factories are suited for such work, and it is not advisable to use them for this purpose.

Hitherto, the Indian trade has been run by *mistris* possessed of much practical experience, but absolutely ignorant of the most elementary knowledge of the principles underlying their practice. It is generally recognised that this can no longer continue, and that if India is to gain the position in the leather world to which she is entitled by reason of the abundance of raw material at her command, the tanning and leather industries must pass under the control of expert technologists, and scientific methods must replace empirical and rule-of-thumb working. Tanning is a chemical industry, in certain stages of which bacteria play an important part, and those who, in the future, would control the industry must be capable of understanding the scientific principles underlying its technique. This means that the students before admission to the tanning trade school should have received a scientific education and should possess a fair knowledge of physics and chemistry. We may take it that the expert tanner of the future should be a graduate in science, and it will be best that his technical studies should only begin after he has completed a university course in pure science. The training in technology must be followed by work in a factory to gain practical experience. These tanning trade schools should be placed alongside the research institutes, which we contemplate will be necessary, and they should be linked up with a college of science on the one hand and a tannery on the other. Ideal conditions would suggest that they should be established in centres of the tanning trade which possess science schools of the highest grade. In such places it would then be convenient to carry on all the work connected with the scientific development of the tanning industry, and the experts dealing with the various branches would be in close touch with one another. There would be the experimental laboratories in which investigations would be going on. Adjoining them, but under independent control, would be the tanning trade schools and, as near as industrial considerations and municipal regulations permit, should be the factories in which the processes worked out in the experimental laboratories would be tried, and where the students from the trade schools would acquire practical experience.

The inferior quality of Indian products is also due to the inferior skill and knowledge of the Indian workmen, especially in respect of the finishing of leathers. Outside the factories engaged on military work, and outside the few small ones which have sprung up as a result of the Madras efforts to introduce chrome tanning, neither currying nor finishing leather is understood or practised, and whatever work is necessary in this direction is undertaken by the Indian *chuckler*, as a preliminary to the actual work of making the article which he has in hand. This can be remedied in the demonstration factories if skilled workmen are obtained from Europe to act as instructors.

Prospect of leather industries in India.

13. The imports into India of finished leather and of goods made from leather are not unimportant, but many of them are the products of specialised factories, which it will not pay to establish in this country till the demand is very much greater than it is at the present time. These imports include :—

(1) Boots and shoes to the value of three or four hundred thousand pounds a year, of which probably two-thirds might well be made in the country.

(2) Belting: the value* of the imported leather belting is very considerable and is likely to increase with the industrial development of the country. Belting can be made in India from selected hides. From the average raw material available it is certain that India will not be able to compete in quality with imported belting, and it is, therefore, unlikely that there will be any serious development in the direction of replacing imports by local manufactures.

*1912-13 . . .	£138,085
1913-14 . . .	167,527
1914-15 . . .	132,315
1915-16 . . .	166,554
1916-17 . . .	203,048

(3) High-class finished leather and heavy leather: the imports are not very large; but it is hardly likely that they will be replaced by leather of equal quality tanned in the country.

(4) Finished skins are imported in large numbers, but there is absolutely no reason why, when skin tanning is properly carried on, these should not be almost entirely made in the country.

The textile mills require large numbers of roller skins, and hitherto these have been imported; but, owing to the stress of war, they are now being made in the country, and in the future importation should entirely cease. The same should be the case with other mill requisites, such as picker bands and raw hide pickers.

The rest of the imports, including saddlery and harness, are of a miscellaneous character, and though some may ultimately be replaced by goods of equal quality manufactured in the country, it is likely that the bulk of these will increase with the growing needs of the country rather than diminish.

The internal consumption of Indian-made leather is by no means accurately known. There are few parts of the country in which the village tanner does not still exist, and there are many small local tanneries of a slightly improved character in the south of India from which the agricultural population gets what it wants.

By far the most important item for which leather is required in India is the water bag by which water is lifted from millions of wells for the irrigation of the fields. To an appreciable extent, in recent years, iron buckets have replaced leather, and efforts are now being made to introduce cheaper fabrics made from vegetable fibres. It is not improbable that the use of leather for this purpose will steadily decrease, and, if such be the case, it will increase the visible supplies of hides on the market.

The Indian demand for boots and shoes and sandals is on the increase; but it is small as yet compared with the vast population. That it will grow in the future is a certainty, and it is likely that for boot uppers and sandals chrome leather will be very largely used. Chrome sole leather has been extensively tried and has proved extremely durable, and, in a country where pavements do not exist, the objection that it is slippery in wet weather has not the force which has practically precluded its use for footwear elsewhere.

The Indian tanning trade must, therefore, look to foreign markets for the sale of its products, and the quantity of raw material is so enormous that it will ultimately need very many large establishments to deal with it, and a high degree of specialisation seems at least possible.

Suggested developments of chrome tanning and leather manufacture.

14. There is not the smallest doubt that foreign countries will endeavour to secure the Indian raw material and to refuse Indian-manufactured leather, as in the past. Assuming, however, that they cannot get the former, they will undoubtedly accept the latter. Future developments must to a large extent depend upon the work done in the experimental factories which have been recommended; but already sufficient experience has been accumulated to show that it is possible to export from India finished leather which meets with a ready market in the United Kingdom. The export of black and brown box sides has reached considerable dimensions, and it is unfortunate that the exigencies of the military situation have temporarily put a stop to this business. A considerable proportion of the Indian cow hides is eminently suited for this class of work and, if it is taken up on a sufficiently large scale under the control of experts in this branch of the leather trade, there are

reasonable prospects of a very extensive commercial development. A large capital will be required to carry on the industry, as this branch of tanning requires workshops equipped with modern machinery. Two important factors will determine the best sites for this branch of the trade:—

(1) The factory must be situated at a centre convenient for collecting the raw material, and this centre should, if possible, be a port where power can be cheaply generated.

(2) There should be in the neighbourhood a sufficient population of the castes willing to work in a leather factory, and capable of being converted into skilled workmen by careful training. The suburbs of both Calcutta and Madras probably best fulfil these requirements, and it is recommended that attention should first be drawn to them as possible sites for the factories which, we hope, will be started.

As has been already indicated, the skins exported from India are of excellent quality; but the attempts to produce finely dressed skins in India have hitherto proved a failure. It is alleged that this is due to the climate, but we are unable finally to accept this verdict. Experimental work under the direction of highly qualified men should be undertaken, and there is little doubt that it will result in success, and in the future it is reasonable to hope that glacé kid, which is now largely made from Indian goat skins, will be exported; also that other finished leathers, such as moroccos, roans, calf skins, and roller skins, will be manufactured not only to meet the needs of India, but to supply those of other countries.

It must, however, be admitted that a very large amount of preliminary work has yet to be done before this branch of the trade can be established so as to compete with the products of countries in which the manufacture is now carried on.

Strong position of India after the war.

15. Till the war is over, and it is possible to form some idea of the international adjustments which will follow, it will be difficult to propose, even in broad outline, the policy which India should adopt to secure for herself the advantages arising out of her resources in hides and skins. The outstanding feature at the present moment is the large increase in light tanning, but this, owing to the scarcity of suitable tanning materials, has to some extent been accomplished at the expense of the skin trade. The continuance, therefore, of the present expansion after the war depends, so far as India is concerned, on the success of the measures which have been taken to provide further supplies; also on whether the external demand for these light tannages for boot uppers remains when military orders cease to dominate the situation. It may be taken as practically certain that there will be a very large increase of tanning materials; but it is less certain that the demand for light tannages will continue on the present scale, and of course much less certain that it will increase. For civilian footware chrome-tanned uppers are now mainly employed, and there is little prospect of any change in this. In the years immediately preceding the war Germany exported to Great Britain on an average more than a million pounds worth of this class of chrome leather and over £400,000 worth of enamelled or patent leathers. Presumably these leathers were largely made from raw materials exported from India, as the German imports were eminently suited for the purpose. In the future, it may be anticipated that this trade will not revive, and that the English market will either be supplied by home tanners working with raw hides imported from India, or by Indian tanners, provided the latter can turn out a finished

product of suitable quality. What will actually happen, apart from fiscal regulations, will to a large extent depend upon the manufacturing capabilities of India.

The depreciation in the value of money has been much smaller in India than in Europe, and it is unlikely that for a long time to come there will be any serious depression in the present high range of prices. This must naturally benefit countries whose currency has been but little affected, and especially those in a position to do a large export trade. The wages of labour have risen in Europe and must be maintained at a much higher level than prevailed before the war. Relatively to the western world, therefore, the cost of manufacturing operations will be less in India than was formerly the case and, to the extent that this is true, Indian industrial development will be encouraged. India has greatly benefited in recent years by her growing importance as a source of raw material for the leather industries. In the future, her position should be even stronger, and it seems almost certain to us that western countries will be prepared to take whatever we are in a position to offer; whether it be raw hides and skins, half or lightly tanned leather, or highly finished products ready for the manufacture of leather goods. To obtain to the full the advantages of the position, it may be necessary to have recourse to retaliatory fiscal regulations; but though the discussion of this is outside our province, we do not consider that there is likely to be much hesitation in applying them. So far as bark tanning is concerned, great progress has already been made, and further developments may be confidently anticipated. On the other hand, for chrome tanning but little has been done, and it is to that branch of the leather trade that attention should be directed. Finally, it is necessary to train workmen in large numbers in the currying and finishing of leather and in skin dressing. The general lines on which Government can best promote industrial progress are explained in our report, and they can be applied to tanning and leather dressing. Only here it must be pointed out that the need for immediate action to take full advantage of the situation is urgent, and that private enterprise is keenly interested and only requires intelligent guidance.

Conclusions.

16. We may now state concisely the conclusions we have reached. India produces a very large, but not definitely ascertained, number of hides and skins which are accounted for under the following heads :—

1. Those wasted in rural areas by the carelessness of the local *chucklers*, or owing to the fact that the hides themselves have become valueless.
2. Those made into inferior leather by the village tanners.
3. Those made into a good class of finished leather by modern tanneries.
4. Those half or lightly tanned and exported.
5. Those exported as raw hides.
6. Those exported as finished leather, and chiefly as chrome box sides. So far, these exports have been insignificant in volume, but they are of great importance as indicating future possibilities.

There seems to be little doubt that after the war new tanneries will be started to produce finished leather for export, and their fate will largely depend upon the quality of the leather which they turn out. Here Government can render valuable assistance by assuming to a large extent responsibility for the technological investigations which have been indicated. Success will result in an improvement of the industry all along the line, beginning with a decrease of waste in rural areas and the diversion of the hides used by the village tanners to modern tanneries, in which a better class of leather will be produced. There will obviously be an increase in the amount of visible raw material; but whether this will be sufficient to meet the growing requirements of the country is a matter on which no definite opinion can be expressed. The general improvement of the technique in tanning will lead to an increase in the exports of finished leather and to a corresponding decrease in the exports of hides. The extent to which exports of finished leather will grow will depend upon the demand from foreign markets not closed by tariffs, and on the extent to which protected markets can be forced to accept leather made in India. Judging by the very great value of the imports of leather into Great Britain from the Continent and from America in the years immediately preceding the war, there is obviously a very important market open to Indian tanners if they can manufacture material of sufficiently good quality. Access to the protected markets is a matter of less certainty ; but there are powerful means which will doubtless be used to ensure it. The position of the manufacturer of half or lightly tanned leathers is less assured. He should be prepared to meet the contingency of a possible decrease in the demand for his products ; and this he can best face by being in a position, if necessary, to direct his energies to the production of chrome leathers.

APPENDIX E

THE MANUFACTURE OF GLASS IN INDIA.

Present position of glass industry in India.

1. The history of the various attempts which have been made during the last 20 years to establish the glass industry in India is extremely instructive, and well worth the careful study of any one interested in the development of the natural resources of the country. It is a record mainly of failure, and such success as has been achieved by a certain number of factories is due entirely to the abnormal conditions created by the war. The cessation of imports from Belgium and enemy countries, and the great scarcity and dearness of freight, have created a position in which about a dozen small factories have found it possible to work with some degree of success. Almost all of them are run on identical lines, and they mostly draw their supplies of raw materials from the same sources. Direct inquiries have established the fact that some of them are, while others are not as yet, working at a profit, and the general conclusion must be that the industry is still on a very precarious basis, and that its continuance will be seriously affected by a return to peace conditions, although the improbability of pre-war prices or freights being reached till some time after the war is a factor in its favour. War profits and increasing practical experience have greatly strengthened the position of manufacturers; but the technical knowledge at their disposal is limited, and rapid progress is only possible if adequate steps are taken to remedy this defect.

Reasons for past failures.

2. The glass industry, even in its simplest forms, is highly technical and can be efficiently carried on only by scientifically trained managers and expert workmen. The present stage has been reached by importing men, only partially equipped with the necessary qualifications, from Europe and Japan, and by sending Indian students abroad to pick up what knowledge they can. The glass industry is a closed trade and its secrets are carefully guarded, so that the latter method has not proved conspicuously successful. More has been accomplished by the men brought out; though their failure to secure commercial success for their employers has generally exposed them to unduly severe criticism. They were practical men accustomed to working under conditions different from those prevailing in India, and their technological skill was quite inadequate to solve the problems presented by a new country. Moreover, they had to produce results as quickly as possible, and were not given sufficient time to make themselves acquainted with the local factors, such as climate, raw materials and the potentialities of the untrained labour available.

It can hardly be questioned that among the imported men, chiefly from Austria and Japan, the Japanese have achieved the greatest measure of success, as they have introduced a small direct-fired pot furnace suitable for melting soft glass, which has been generally adopted with satisfactory results, and they are responsible also for the present supply of trained glass blowers. The gas-fired regenerative furnaces of the Siemens' type were naturally introduced by the continental experts; but they require the employment of a higher grade of fire-resisting material in their construction than until recently was available, and also more skill and experience in their actual working. Quite a number have been erected and have failed; but some degree of success has latterly attended the work of an Austrian, by name Mozina, who was first brought out as a glass blower to the Rajpur factory, was subsequently employed at Jubbulpore and Allahabad, and is now at Firozabad making bangle glass in a ten-pot gas-fired furnace at the Indian Glass Works in that town.

India's demands for glass.

3. The demand for glass in India is to some extent indicated by the imports in the sea-borne trade returns which are classified under the following heads :—

Articles.	1913-14.	1916-17.	1917-18 (Provisional figures).
	Value in lakhs of rupees.		
Bangles	80	43	35
Beads and false pearls	24	21	24
Sheet and plate glass	22	28	23
Lampware	17	11	19
Bottles and phials	14	16	37
Soda-water bottles	6	9	
Table ware	8	7	10
Miscellaneous	19	15	15
Total . .	190	150	163

The effect of the war is shown by the figures for 1916-17 and 1917-18. But the returns are only comparable, if it be remembered that values have increased enormously, and it can be safely said that India is now importing less than one-half the quantity which came into the country in the year immediately preceding the outbreak of war. The glass manufactured in India is chiefly bangle glass, almost exclusively made at Firozabad, where six factories turn out about 15 tons a day, and soft glass for such articles as lampware, tumblers, jars and carboys. No data are available from which an accurate estimate of the outturn of all the factories can be framed, but from the values furnished by the owners of some factories it is probable that the total output for all India is now worth about 20 lakhs of rupees a year. This is not a very encouraging result after an expenditure of probably not less than 50 lakhs of rupees in the various attempts which have been made to establish the industry. But it is sufficient to suggest the possibility of great expansion with proper help and guidance.

Classification of problems to be solved.

4. With these preliminary remarks, we may pass on to a more detailed discussion of the various problems which must be solved in the immediate future, if the Indian glass industry is to be placed on a more permanent basis. These may be classified under the heads :—

(1) Raw materials;
(2) Direction;
(3) Labour;
(4) Climate;
(5) Location; and
(6) Markets.

Consideration of these factors will show clearly the necessity of co-ordinated research by a properly equipped Government Department of Industries.

Raw materials.

5. The most important raw materials are sand, lime, soda, fireclay and coal. For the last it may be presumed that Bengal will continue, as at present, to be the chief source of supply; but in regard to the main constituents of

glass—sand, lime and soda—it is by no means certain that further prospecting work would not reveal new and possibly more suitable sources of supply. Most of the existing glass works depend upon the sandstone found at Logra, about 11 miles from Naini, and it is used in factories as far apart as those at Ambala, Allahabad, Talegaon and Bombay. Suitable sand has also been found, and used at one time or another, at Jejo in the Jullundur district, at Jubbulpore, and at Ennore near Madras. Lime of suitable quality occurs more frequently than sand, but it is by no means conveniently distributed in reference to the majority of the glass works, and its cost is an item still susceptible of considerable reduction. A cheaper source of soda is, however, a matter of much greater importance, and to this end attention may be seriously directed to the *usar* soils of northern India, which contain both the carbonate and the sulphate. The quantity available is large; but it is doubtful if the deposits are anywhere rich enough to make it worth while to extract these salts. Although perhaps a forlorn hope, the investigation should nevertheless be undertaken.

In respect of both furnaces and crucibles or pots, the Indian glass manufacturers have so far been at a great disadvantage, since, in order to obtain a reliable material, they have had to import either from Europe or Japan; but matters are improving under the stimulus given by the development of the iron and steel industry. Jubbulpore and Kumardhubi are the two Indian centres of greatest moment in respect of the supply of fire-resisting materials; but it is doubtful whether as yet the best results have been obtained from the clays and minerals available. Local attempts are being made by the managers of most glass works to prepare their own pots, but so far with limited success, and the industry is still to a very undesirable extent dependent upon Japanese ware. The temperatures in the Indian glass furnaces are by no means high, but the wear and tear of the inferior material employed greatly adds to the cost of production.

Direction.

6. By a process of trial and error, a method of manufacturing glass from Indian raw materials has been evolved; but, as already stated, it is only profitable because of the abnormal state of the market. The present stage is obviously transient; but it is important, inasmuch as it gives some degree of confidence to capitalists to move forward, and it provides an opportunity to train blowers and workers in glass. There is no one in the country capable of developing the industry adequately either on its technical or commercial side. The economics of the glass industry have doubtless been studied with care by those in the trade; but the conclusions have never been published, and to a large extent the data on which they are based are not available. It is held by some that the glass industry should be located near its market; by others that it should be near the source of the supply of raw material, particularly fuel. These are opinions based upon inadequate data regarding the cost of carriage to assemble raw material and to distribute the manufactured goods. It is possible that the selection of a site should be governed by other considerations, of which a free supply of labour may be the most important, though again it may be largely influenced by climate. Much might be learnt by a study of the distribution of the glass industry in other parts of the world, and information could be collected which would throw some light on these debatable points. It seems necessary that this should be done; and it is certain that it can only be undertaken at Government cost, as it will involve expenditure which cannot be balanced by commercial assets.

The industry so far has been developed in a haphazard way, and without that preliminary investigation by qualified experts which is essential to meet competition from other parts of the world. It is not desirable that the present state of affairs should continue. Such success as has already been achieved has been purchased at too great a cost, and the future is likely to be barren if more intelligent and less expensive methods are not introduced. The glass industry is the result of experts working in co-operation, and there is no such individual as the "glass expert," capable of expressing an authoritative opinion on all the points which must arise in pioneering the industry in a country where it has not hitherto existed, and which possesses no marked natural advantages to help it in the initial stages. An organisation is wanted to take up the whole industry, including men who can deal with the furnace problem, the preparation of refractory materials for furnaces, crucibles and pots, the chemistry of glass, the manipulation of the crude product and its conversion into finished forms, whether by skilled blowers or by highly complex and semi-automatic machinery.

It is impossible to say meanwhile whether the future of the industry in India lies in the small factory and the development of the skill of the operative, or in the establishment of large works and the extensive employment of machinery. Preliminary enquiries by competent economic investigators are required to determine tentatively the best method of procedure, and, with these results in hand, technical experts should be called in to review the situation and indicate the direction for further efforts. Protective tariffs may bolster up the existing factories, but they will prove ineffective, unless they give rise to scientific inquiry and expert treatment of the many problems involved. To establish a tariff and then to trust to private effort is not likely to be productive of satisfactory results. Clearly, the State should take the lead, employ the experts, and place them in charge of practical work; and if tariffs are employed, it should only be so far as is necessary to protect the industry in its infancy.

Labour. 7. The glass blower is a skilled workman whose training is unusually costly, as in the process of acquiring his skill, not only does he waste a large amount of raw material, but it is raw material which has to be maintained at a high temperature. A good deal of experience has been accumulated in India regarding the training of glass blowers; but it has not yet been sifted carefully to ascertain what general principles emerge for future guidance. Every factory complains of shortage of labour and the difficulty in training fresh hands. Useful work has been done by the Paisa Fund at the Talegaon glass works, and it is certain that the recent developments of the glass industry in India have only been possible by reason of the blowers trained in this factory. At present the glass blower dominates the situation, and there is much friction between masters and men. No great amount of progress is possible without a much larger number of blowers, and as the training of each man is a heavy expense, masters are reluctant to incur it without some guarantee that they will reap where they have sown. Factories might be subsidised by Government to do more work in this direction; but what is more likely to prove effective is the institution of a system of apprenticeship, whereby the master engages to train apprentices in the art of glass blowing, and in return secures a lien on their services for a period sufficiently long to recoup him for his initial expenditure. Experience seems to indicate that boys between 12 and 14 may be taken on as apprentices, and that in a year or two they become sufficiently expert with the blowpipe to turn out blown glass of marketable quality. Seven years was usually the period of indentures in England before the days of polytechnics and technical schools, and it is believed to be still the customary period in many trades, especially those which are closely governed by Trades Unions. A seven-year system of apprenticeship might, therefore, well be adopted in the Indian glass trade, and there is no doubt that, with suitable provision for remunerating the apprentices fairly in proportion to the degree of skill they acquire, it would be popular. Whether the apprentices should be bound to the proprietor of the factory or to the master glass blower is an open question. Unless the master glass blowers have an interest in the matter, it is hardly likely that they will prove efficient instructors of the apprentices.

Climate.

8. Experience also seems to show that climate is not such an important factor as was originally supposed, and no real difficulties with labour have occurred which can be attributed to the high temperatures that prevail during the greater part of the year in India. It is necessary, however, to close down for a short period in order to rebuild and repair the furnaces, and this might well be done in the hot weather. Though climate may be no very serious matter in the working of a glass furnace, so far as the human element is concerned, it by no means follows that it can be neglected in considering the design and construction of the furnace itself.

The high temperature of the air, when combined with a high percentage of humidity, probably affects the working of the furnaces very unfavourably, and it is possible that not a little of the irregularity in the quality of the product turned out in the Indian glass works is due to this cause. The effect of moisture on the working of the blast furnaces in America is well known, and in certain parts of the country the air supplied to these furnaces is artificially dried with great advantage. No evidence regarding these conjectures has been brought forward by Indian glass blowers, and it is only suggested that the point is worth investigation. For instance, before establishing large glass works in the neighbourhood of the coal fields of Bengal, where the atmosphere for many months in the year is very humid, it would be desirable definitely to ascertain to what extent the humidity of the atmosphere is likely to be prejudicial to the satisfactory working of the furnaces.

Location.

9. One object of this note is to draw attention to the absence of information which ought to be available regarding the conditions under which glass can be made in this country, and to point out that this unfortunately has not so far been collected. Till the economics of the industry have been carefully studied, till all the sources from which raw material can be drawn have been investigated, and till the effect of the climate upon the working of the glass furnaces is determined, it is impossible to indicate the best location for the glass industry. The question ought to be studied in a scientific way, and not left to be determined by the evolutionary process of the survival of the fittest.

The cry for protection, especially for infant industries, is partly engendered by the haphazard way in which pioneering work has been done in the past. The question of protection is not now under discussion, but it is relevant to point out that there is much less necessity for it when proper preliminary investigations are made previous to the actual starting of work. There can hardly be any doubt that the very meagre results, which have attended the efforts to establish new industries in India, have been due to the lack of this essential precaution. The glass industry is a conspicuous example of the unscientific, whilst the steel works at Sakchi are an equally conspicuous example of the scientific, method of starting new industries. The splendid financial results in the latter case are largely due to the war; but there is no reasonable doubt that, even if there had been no war, these steel works would have eventually been a very successful commercial undertaking. At the present moment, all that can be said with regard to the location of the glass industry is that the balance of advantage seems to lie in the neighbourhood of the coal fields of Bengal, and for the two reasons, that fuel there is cheap and that the largest market for glass in India is in close proximity.

Markets. 10. In normal times, the principal demand for glass manufactured in India was in the form of bangles and beads; but, since the outbreak of war, glass for utilitarian purposes forms a much larger percentage in the imports. A very considerable proportion, probably half, of the lamp glass required in the country is now manufactured in India by the glass works which have been established in recent years. As has been already pointed out, the very great rise in the value of glass imports is largely due to the increased cost of the glassware, and not to increased quantities imported. In the case of "beads and false pearls," "bottles and phials", and "sheet and plate glass," information regarding the quantities imported is also available. These show that in the case of "beads and false pearls" prices have nearly doubled; that in the case of "bottles and phials" they have increased over 50 per cent; while in the case of "sheet and plate glass" prices have more than doubled. Under what may be termed extraordinarily adverse conditions of price and supply, the demand for glass has been fairly well maintained, and it may be assumed that after the war it will largely increase. Usually, no small amount of glass comes into the country in the form of bottles, phials and jars containing liquors and preserved provisions of various kinds. This unrecorded import has seriously decreased, and with it, therefore, the second-hand supply of such glassware; on the other hand, this second-hand supply is in much greater demand than was formerly the case and has, therefore, been more fully utilised.

Conclusions. 11. The foregoing preliminary discussion of the glass industry in India has shown how numerous are the factors, technical and economic, which require examination before any hopeful line of advance can be indicated with safety. Chemical investigations into the nature of the raw material, into questions of climate, the behaviour of furnaces, and the suitability of the various refractory materials available, will have to be conducted concurrently with the collection of information regarding the availability of the materials, the cost of their transport as compared with that of the manufactured article, the extent of the demand and the degree of its concentration in different markets. It is also desirable to know how these factors have affected the location of glass works in typical places outside India. Such an enquiry really indicates the necessity of a department which can command and co-ordinate the services of the different technical experts required, and is able to examine the economic questions involved. The interdependence of all these factors shows the hopeless wastefulness of isolated inquiries by individual experts in different parts of India. On the assumption that the problem is approached with due seriousness, the prospects seem promising. There is no reason why India should not be made self-supporting in the matter of lampware of all kinds, except of the very highest quality, why, under proper technical and scientific guidance, it should not be able to manufacture all the bottles, phials, jars and containing vessels which it is likely to need. There is a sufficient demand for sheet glass to justify attempts to manufacture it in the country; but progress in this direction will inevitably be slow, as the industry is still one in which machinery plays a very small part and the manipulation requires great experience and a high degree of skill.

APPENDIX F.

SALTPETRE.

The Indian saltpetre trade.

1. The principal sources of saltpetre in India were, before the war, in order of importance, Bihar, the United Provinces and the Punjab. It is prepared, as will be described in more detail below, by solution, concentration and subsequent refinement from earth containing nitrates, the product of bacterial action in the soil in and round villages, where a large quantity of nitrogen is derived from the excreta of men and animals and the decay of vegetable matter. Up to 1860 or a little later, India was almost the only source of saltpetre, and, when the French were deprived of the Indian supply during the Napoleonic wars, they found it necessary to meet their war requirements from artificial nitre beds. Prior to the Indian supply becoming available, saltpetre was obtained in England, at any rate, by the removal and treatment of earth from the neighbourhood and even the interior of dwelling places, under the authority of the Crown, a measure which was often worked very oppressively.

The discovery of a method of making saltpetre artificially from the nitrate deposits of South America and the German potash beds hit the Indian trade very hard, and not the less so that this discovery nearly synchronised with the imposition of an export duty of Rs. 2 a maund by the Government of India in 1860. Though the duty was removed after a few years, the trade to England and the United States of America, who were India's principal customers for highly refined, or, as it is called, low refraction saltpetre, declined until after the outbreak of war. This is proved by the following export statistics :—

Annual average of period.	To U. K.	To U. S. A.	Total Exports.
	Figures are in cwts.		
Year 1862-63 ...	...	...	105,060
Year 1864-65 ...	...	...	220,860
15 years ending 1905-06 ...	96,605	102,755	368,461
5 years ending 1910-11 ...	80,487	119,128	360,698
3 years ending 1913-14 ...	47,696	47,622	279,801

There is, however, a very well maintained demand from China, mostly for the manufacture of fireworks, and from Ceylon and Mauritius for manure. In these cases the saltpetre is shipped on a high refraction basis. It is not clear why an impure variety of saltpetre is apparently preferred for manurial purposes. Nothing is gained in the price paid for the actual saltpetre, while freight is heavier, and the impurities appear to possess no direct manurial value. The figures given above do not differentiate the classes of saltpetre shipped.

Figures for prices are shown in the statement below.

Prices at Calcutta per factory maund of 74·67 lbs. of saltpetre (5 per cent crude) during January and July of each year 1897 to 1916.

Year.	January.			July.			Year.	January.			July.		
	Rs.	A.	P.	Rs.	A.	P.		Rs.	A.	P.	Rs.	A.	P.
1897 . .	6	1	0	6	4	0	1907 . .	8	4	0	9	8	0
1898 . .	5	15	0	5	12	3	1908 . .	8	10	0	8	8	0
1899 . .	6	5	0	6	7	0	1909 . .	8	2	0	8	6	0
1900 . .	6	12	0	6	8	0	1910 . .	8	8	0	9	0	0
1901 . .	6	5	0	6	12	0	1911 . .	10	8	0	11	8	0
1902 . .	6	11	0	7	0	0	1912 . .	11	4	0	11	8	0
1903 . .	6	9	0	6	14	0	1913 . .	11	12	0	11	8	0
1904 . .	7	0	0	7	4	0	1914 . .	12	3	0	11	4	0
1905 . .	8	8	0	9	0	0	War { 1915 . .	11	12	0	11	4	0
1906 . .	8	6	0	8	8	0	1916 . .	13	4	0	15	8	0

Effects of the war on the industry.

2. Shortly after the outbreak of war, steps were taken to increase the output of saltpetre, which had already been stimulated by the rise in price. *Nunias'* license fees in the United Provinces were reduced from Rs. 2 to Re. 1, the Bihar license fee already being only 4 annas ; some of the areas hitherto closed to saltpetre extraction on account of the relatively high proportion of salt contained in the earth were thrown open, licenses were issued through the agency of the Post Office, and refiners were allowed to compound for the common salt that they were likely to manufacture. The effect of these measures and of the rise in price is shown in the increased export during the next two years :—

Years.	Quantity in 000 cwts.
34 years ending 1913-14 (average)	280
1916-17	525
1917-18	456

In order to secure the maximum supply for munitions, the export of high refraction saltpetre to the Colonies and China, which had risen in price in greater proportion than the low refraction quality, was stopped for some time. Subsequently, owing largely to market manipulation rather than to any increased price obtained by the *nunias,* selling rates rose so high that they had to be artificially restricted, and the export of saltpetre was prohibited if shipped at any higher prices than £28-10 per ton for 95 per cent. and £25-15 for 90 per cent. purity. These rates were subsequently increased and readjusted.

The following extract from a note by the Commissioner of Salt Revenue in Northern India, illustrates the recent development of the industry under war conditions.

"With the increased demand for saltpetre that arose with the war and the good prices that have been obtainable the industry has been resuscitated and, but for the extraordinary rains, exports in 1917 in all probability would have reached 40,000 tons, and, as nothing but low refraction saltpetre can be exported, this is really the equivalent of at least 50,000 tons in normal times. The following figures are of interest :—

	Number of licenses issued for production of crude saltpetre.			Number of refineries			Production of refined saltpetre in maunds.		
	Bihar.	United Provinces.	Punjab.	Bihar.	United Provinces.	Punjab.	Bihar.	United Provinces.	Punjab.
1913-14 .	24,545	5,275	1,371	213	82	32	1,85,373	1,69,756	87,010
1914-15 .	29,970	6,270	1,648	205	83	33	2,22,123	1,88,386	1,06,176
1915-16 .	30,501	8,495	2,291	213	95	37	2,19,565	2,36,658	1,52,301
1916-17 .	30,251	11,169	3,467	227	128	48	2,41,038	3,00,566	2,45,976

Licenses were applied for in the case of only 400 formerly proscribed villages, but 1,500 other villages were worked for the first time. The development of production in the Punjab has been remarkable and has not yet reached its maximum."

Government control of saltpetre manufacture.

3. Before dealing with the methods pursued for the extraction of saltpetre from the soil and its subsequent refinement, it may be of interest to discuss in more detail the gradual increase in the restrictions imposed on the industry in Bihar and the present position of the preventive organisation in Northern India.

Prior to the year 1869, the control of saltpetre production, which was maintained in the United Provinces by the Inland Customs Department, did not extend to Bengal. But the results of an enquiry proved that, in addition to the 330,000 maunds of saltpetre manufactured in the latter province, 300,000 maunds of salt of a quality suitable for human consumption were also made at a loss to the salt revenue estimated at 10 lakhs of rupees. The control which was at first introduced did not extend to the *nunias,* who produce the crude saltpetre from the village earth, but was applied only to the refiners. In 1880 the Government of India placed the control of saltpetre manufacture in the Patna Division under the Commissioner of Inland Customs, and in 1889 the jurisdiction of the Commissioner of Northern India Salt Revenue, as this officer had by that time become, was extended to the Bhagalpur Division. In the course of the enquiries which led to these steps being taken, a good deal of information was elicited regarding the necessity of supervising the operations of the *nunia* and refiner. The system of control which was then created has been maintained on much the same lines ever since, and now extends to the Punjab, United Provinces and Bihar. But in 1877 the opinion of the Bengal Government was that the import of duty-paid salt into a district was low, when the production of saltpetre and, therefore, the eduction of salt was considerable, and *vice versâ.* At the same time, it was stated that the production of this class of salt was likely to decrease with a rise in the standard of comfort of the people, the *pakwa* salt, as it was called, being very inferior, and only being eaten by "the poorest and most miserable of the population." The reason, it was alleged by the Bengal Government, why their system left the operations of the *nunia* uncontrolled was that, unless he was allowed to make what he could out of the salt, he was unable to earn a living. No information can be obtained as to the effect of the restrictions imposed on these two occasions on the Patna and Bhagalpur Divisions; Mr. Ashton, who enquired into the matter on behalf of the Salt Department in 1888, reported that the conditions of the industry in the Bhagalpur Division were no better than in the Patna Division, where the industry was under close control. The preventive staff now employed is quite insufficient to stop any deliberate attempt at the production of illicit salt. In the Saran circle of Bihar, one circle officer and five inspectors attempt to supervise 18,000 workers scattered over an area of 6,000 square miles. There is no circle officer and only one inspector in the whole of the Punjab; and it is certainly time to consider whether this inadequate control should not be terminated or put on a fresh basis.

The degree to which the restrictions on the manufacture of saltpetre, imposed in the interest of the salt revenue, might justifiably be relaxed, depends on the demand for saltpetre—whether as a source of explosives or other manufactures, or for its manurial value in India and countries comparatively near India—a factor which is likely to be affected by the degree of importance which may be attached to the maintenance of a British Empire source of supply. It is likely that the demand for these purposes will assume considerable importance. Gunpowder will always be wanted in large quantities, while the preservation of foods and the manufacture of glass also require saltpetre. The lines of action that should be pursued should be, in the first place, to systematise, improve and cheapen the processes of manufacture. This will give a suitable basis for the next step, the increase of the sources of production by means that will be described below.

Description of the *nunia's* processes of manufacture.

4. The *nunias* manufacture crude saltpetre as follows. During the dry season they scrape the earth from village roads, mud walls, etc. For this privilege they pay rents to the zamindars and tenants, which have, since the rise in prices occasioned by the war, become very heavy. The earth so collected, mixed with an equal weight of residual earth from the previous season's working (*bhinjua*), is placed in a filter consisting of a low wall of clay with an orifice at the bottom; the wall surrounds a smooth surface of clay, sloped towards the orifice. Above this surface is placed a false bottom of bamboo and straw or matting, and the earth to be dealt with is very carefully heaped on it. Water is poured over the earth, and the liquor that runs through, which

contains salt and other substances as well as saltpetre, is allowed to settle and is then boiled in iron pans or evaporated by the heat of the sun; when this process has sufficiently concentrated the liquor, it is then left to cool, and the crude saltpetre, still containing a good deal of salt, crystallises out, and is scraped off and sold to the refiners. Under the terms of his license, the *nunia* is not allowed to carry the process further and extract salt.

5. The Imperial Agricultural Bacteriologist, who has prepared a bulletin on the subject of the *nunia's* operations, describes the way in which the *nunia* makes use of the nitrates left over by his process. He collects (1) the final fraction of the liquor, too weak to concentrate by itself, that comes out of his earthen filter, and mixes it (2) with the residual earth from the filter, from which most of the saltpetre has been dissolved out, (3) with the mother liquor in his pot, remaining after the separation of the first lot of saltpetre by crystallisation, and (4) with some ashes from his furnance. Some of this mixture (*bhinjua*) is stored till the following season; this is only the case with what is left over unused; most of the *bhinjua* is used as soon as it is prepared; but the residual earth (*sitta*) from the filter is kept for a year before being made into *bhinjua*. By these and other means, the *nunia* saves a great deal of the saltpetre that remains over from his original process. Were he allowed to carry concentration by boiling further in that process, he would recover at once a larger quantity of saltpetre, but would also destroy a proportion of the remaining nitrates in doing so. The Imperial Agricultural Bacteriologist thinks that more investigation is needed to discover whether, supposing the *nunia* were allowed to continue with his concentration process to a further stage, any considerable proportion of the nitrates at present wasted by the combined process described above could be recovered. He has found that something like 25 per cent. of the total nitrate passing through the *nunia's* factory must be lost, unless the *nunia* proceeds further and recovers it by what is at present an illicit process; while that process is itself so inefficient that, even if the *nunia* were allowed to pursue it unmolested, it would probably result in the loss of at least 40 per cent. of the 25 per cent. at present wasted.

Returning to the description of the *nunia's* ordinary process, it must be also noted that he takes the organic and earthy impurities thrown down in his concentration process and adds them to the crude saltpetre which he sells to the refiner. This is partly to impress the salt subordinates with an idea of his *bonâ fides* from the dirty appearance thereby given to the saltpetre, proving that the *nunia* has not proceeded beyond the legitimate stage, and partly because this substance contains some organic nitrogen, as well as saltpetre residue, which the refiner uses in a way which will be described later. The process, therefore, is not so entirely wasteful and illogical as supposed by the present Director of Agriculture in the United Provinces, who has also discussed the subject, as the refiner is able to save what might otherwise be wasted by the *nunia* under existing conditions, though the *nunia* could no doubt make better use of this refuse by adding it to the mixture which he makes already for use in the following season.

Manufacture in the refineries.

6. In the refineries, which are rather more systematised than the *nunia's* humble outfit, saltpetre is produced in two ways. The *nunia* brings the crude saltpetre to the factory, and this is dissolved in the mother liquor from the crystallising vats, which is already saturated with sodium chloride. By heating to the boiling point, the potassium nitrate is dissolved, and during subsequent concentration the sodium chloride is deposited as crystals and fished out. There then remains a saturated solution of both potassium nitrate and sodium chloride which, on cooling very slowly in a separate vat, yields large

crystals of nearly pure potassium nitrate. This is due to the less solubility of this salt in cold than in hot water, while the solubility of sodium chloride is almost unaffected by change of temperature. It is necessary that the cooling should take place extremely slowly to allow of the growth of the crystals to a large size. Rapid cooling would lead to the deposit of small crystals from which it would be difficult to drain away the mother liquor. In the improved process devised by Dr. Leather, formerly Imperial Agricultural Chemist, this difficulty is eliminated by the use of centrifugals for drying the saltpetre crystals. The other refinery process consists of the treatment of the earth round the refinery, which is saturated with the waste saltpetre-resulting from the working of the factory and has had added to it the impurities from the crude saltpetre, which partly consist of the refuse of the *nunia's* boiling pans. The saltpetre is recovered much on the same principles as those adopted by the *nunia*, but with rather better plant and greater care. The Imperial Agricultural Bacteriologist gives good reason to believe that, both in this case and in that of the earth taken by the *nunias* from village sites, the saltpetre content increases, if the earth is stored under proper conditions for a period. Salt is educible by the above process just as in the case of the *nunia's* working. The refiner has the option under his license of paying duty on his salt and passing it into consumption, or of having it destroyed. The proportion of salt produced from crude saltpetre depends on the composition of the nitrous earths. In the United Provinces these generally contain a great deal more salt than in Bihar. Estimates for the latter province made some years ago allow for anything between 10 and 20 per cent. of salt being educed from the total of the crude saltpetre taken into refineries and of the nitrous earth dealt with by them under the second process described above.

The Imperial Agricultural Bacteriologist explains that the reason why this double process is followed is partly owing to the fact that the refiner can store his refuse earth, and can start work on it immediately after the rains and before the crude saltpetre produced by the *nunias* has begun to come forward.

Under the terms of his license, for which a sum of Rs. 50 is charged, the refiner must not change the number of his pans and boilers without sanction, must maintain a register showing his purchases and production, and must not remove any saline substance other than saltpetre without sanction; and, if such substance be salt, without payment of duty thereon, unless he elects to destroy it.

The position in the Punjab and in the Muttra district of the United Provinces is different. The refiner is, as a rule, a man of capital, who takes out licenses for the manufacture of crude saltpetre in his own name, employs his own servants in the manufacture and is responsible for all contingent expenditure. Moreover, owing to the greater cost of fuel, the process adopted is usually that of evaporation by solar heat, and this is not possible till later in the season than when evaporation is effected by artificial heat.

How far the system of control is necessary.

7. The Imperial Agricultural Bacteriologist forms no definite conclusion regarding the practicability of any relaxation of excise precautions. He states, however, that the resulting salt is so inferior, on account of the admixture of chlorides and sulphates of potassium, magnesium and calcium, that it is practically unmarketable for human food; and that the same is, in fact, the case with the refiner's salt, who usually destroys it, rather than accept the small margin, some four annas per maund, between its sale price and the duty he has to pay. This statement is quite at variance with Mr. Ashton's statement that the salt produced by the Calcutta refineries is practically unidentifiable from Liverpool

salt with which it was sometimes mixed, except by the presence in the former of a trace, at least, of saltpetre. The percentage of sodium chloride in this so-called *pakwa* salt was between 80 and 94, after refinement. It was produced by no better processes than are available to the refiner in Bihar; and it is the opinion of the present Northern India Salt Revenue Commissioner, based on the results of numerous seizures of illicit salt, that even the *nunia* can undoubtedly, if left to himself, produce a thoroughly marketable article.

So far as the disposal of the salt produced by the refiner throws any light on the use and nature of the *pakwa* salt, the only figures available seem to be the following. In 1881, *pakwa* salt was sold by the refiners at rates which were usually between Rs. 3 and Rs. 3-8. The duty at the time was Rs. 2-8. Apparently the above sale prices included the duty. In 1883-84, the salt educed was 38,550 maunds, of which 27,547 maunds were excised. In 1905-06, 19,718 maunds were educed, of which 16,262 maunds were excised. The consumption of duty-paid salt per head in Bihar was 9·89 lbs. in the three years 1881 to 1884; in the three years 1903 to 1906 it was 9·82 lbs. The Salt Commissioner doubts the correctness of the previous figure. A better selection of periods would have shown how far the improved control increased the consumption of duty-paid salt, but figures are unfortunately not forthcoming.

In 1868 the price of salt was Rs. 6-7-10 per maund. The price of salt less duty immediately before the war was much lower than the price of salt during the period when excise precautions were being increased, less the higher duty then prevailing. The margin of profit to the seller of illicit salt for local consumption would thus now be less, not only by the reduction in the duty, but by the drop in the cost and profit apart from that duty. Thus in 1914 salt was reported by the Commissioner, Northern India Salt Revenue, to be selling at Rs. 2-2-4 per maund at Allahabad, inclusive of Re. 1 duty. The duty has since been raised to Re. 1-4-0, but the danger of illicit sale will be much less now than in the days when it was found necessary to impose restrictions, at any rate when normal supplies are again available. The actual amount of salt likely to be produced is not considerable. In 1907 it was calculated that the *nunias* of Bihar and the United Provinces, if left to themselves, could produce about two lakhs of maunds of edible salt. It was officially reported from the United Provinces in 1914 that the salt from refineries was worth only 4 annas a maund over and above the duty of Re. 1. It must be remembered that the salt educed is, though edible, below standard quality. The illicit trade might bring some profit to the *nunia*, but whether it would result in any decrease in the consumption of licit salt seems very doubtful.

In addition, however, to the areas which are regularly worked for saltpetre, there are others of considerable importance which produce so large a proportion of salt that they would not yield enough saltpetre to pay expenses, and the output of salt would be a serious item. The entire withdrawal of the preventive staff would lead to these areas being worked freely, without any appreciable increase in the outturn of saltpetre. We have also seen that, in spite of assertions to the contrary, the *nunia* and the refiner are both able to produce edible salt in quite appreciable quantities. It seems, therefore, inadvisable to release the manufacture of saltpetre entirely from excise precautions; but there is a strong case for changing the existing arrangements in directions which will encourage the output of saltpetre, while not adding seriously to that of illicit salt. The method in which this may be done will be indicated below.

The Imperial Agricultural Bacteriologist makes a suggestion that, if it is not considered practicable to abolish excise precautions, the saltpetre pay a duty of four annas a maund and that the salt be allowed to go free. If the duty took the form of an excise, the *nunia* and refiner would be allowed to carry their processes to the utmost extent that was profitable, but supervision would have to be exercised over both of them, to see that they did not escape duty. The result of this control would not be perhaps less irksome and deterrent than the present system, though of course there would not be the same direct incitement to waste. As a practical proposition, however, it does not appear that the saving of the waste would help the industry nearly as much as the saving of the worry inflicted on the *nunias*. In any case, some watch would have to be kept to see that *nunias* did not work in areas that contained a minimum of saltpetre and a maximum of salt. It is believed that there are fairly numerous areas that would have to be entirely prohibited for this reason.

Suggestions for increasing the sources of saltpetre.

8. The Imperial Agricultural Bacteriologist's general conclusions are summed up as follows. The existing sources of saltpetre are not fully utilised owing to certain drawbacks, which include the control of the Salt Department and the low price of crude saltpetre. This latter feature is due to the inability of the *nunias* to combine and to the mastery of the situation thereby possessed by the refiner, who pays Rs. 5 for crude saltpetre containing about 50 lbs. of the pure article, and sells refined saltpetre, containing about 72 lbs. of the pure article for Rs. 12. The question of introducing co-operation among *nunias* is worthy of consideration, but the most probable solution of the difficulty appears to be the establishment of model factories under Government control, or belonging to a more reliable class of private owners.

Artificial nitre beds, in which nitrates are produced in the soil by the decomposition of *sann* hemp (Crotalaria juncea) or other easily obtainable organic matter might be a useful additional source of supply, especially if concentrated round a central factory for economy of manufacture and, if necessary, of control. They have a special advantage in the practical absence of salt from the saltpetre so obtained. A few experiments in this direction have been already made at Pusa, with promising results.

Improvement of methods of production.

9. The *nunia's* present methods result in the waste of some 25 per cent. of the available nitrates. It is necessary to ascertain whether more efficient methods can be devised, and, if so, whether these would assist in the withdrawal of the present system of control. It has already been stated that Dr. Leather devised a process which is a considerable improvement on that at present adopted by the refiner. This process was shown in the Allahabad exhibition, and the plant is still lying at Pusa. It does not seem, however, that any steps, at any rate effectual steps, have been taken to demonstrate it. The method may be looked at, however, merely as an initial attempt to improve the industry and as a sample of what may be expected from methodical work on a commercial scale. The results of the Imperial Agricultural Bacteriologist's investigations also give ground for hope that the saltpetre contents of the earth can be improved, and that saltpetre may be generated artificially in considerable quantities. The position justifies experimental working on a large scale with expert assistance and control. There is sufficient work for a bacteriologist, a chemist, and a chemical engineer in the initial stages; and the result may very likely be a great increase in the output of saltpetre, with a saving of waste and a cheapening of production. The work should at first be taken up by the Imperial Department of Industries, or by a single Local Government, and the results so obtained should be demonstrated by the provincial Departments of Industries.

Transference of control to Local Governments.

10. Whatever may be the risks of illicit salt production in saltpetre manufacture, it is clear that the present system, with a microscopic preventive staff working over enormous areas which contain thousands of *nunias*, is

ineffective. A better course would be to hand over to the Local Governments of the Punjab, the United Provinces, and Bihar and Orissa the control of salt excise, and therefore of saltpetre production, whether by *nunias* or refiners, making any financial adjustment that may be necessitated by the cost involved on provincial revenues and the receipts obtained from what has hitherto been an imperial source of revenue. The local Excise Departments might, as in Bombay and Madras, be the agency for the control of salt production, and their larger staff and better local organisation would, in point of efficiency at any rate, make them a preferable instrument to the Northern India Salt Department. The encouragement of the industry on the lines suggested above would be the concern of the local Departments of Industries, and co-operation between these and the Excise Departments would, no doubt, result in the control being reduced to a minimum and exercised in the least vexatious way. The Department of Northern India Salt Revenue could then devote its energies to the production of salt, and arrange for the fuller and more efficient exploitation of the vast sources of salt under its control.

APPENDIX G.

SERICULTURE AND THE SILK INDUSTRY.

Basis of note.

1. The silk industry in India has recently been the subject of detailed enquiry by Mr. H. Maxwell Lefroy, assisted by Mr. E. C. Ansorge, I.C.S., and their report to the Government of India has been communicated to us. Both gentlemen appeared before us as witnesses, and to a large extent the following notes on the position of the silk industry in India are based upon information collected by them.

Extent of sericulture in India and existing position of the industry.

2. The subject is one of great complexity, requiring considerable technical knowledge for its elucidation, and it can only be dealt with here from a general administrative point of view. At the present time, there are three tracts in which sericulture is an industry of some importance:—(1) In the south of India, the southern half of the Mysore plateau, with the adjoining taluk of Kollegal in the Madras Presidency; (2) Bengal, chiefly in the districts of Malda, Murshidabad, Rajshahi, and Birbhum; (3) Kashmir and Jammu, with the neighbouring sub-montane districts of the Punjab. There is also a considerable industry in Chota Nagpur, Orissa, and part of the Central Provinces, dependent on the *tasar* silkworm, and in Assam, on the *muga* and *eri* silkworms. The *tasar* is stated by Mr. Lefroy to be a wild silkworm, never successfully domesticated, which lives in forest areas chiefly, and which feeds on a variety of trees. The *muga* is a semi-domesticated worm reared entirely in the open on trees, chiefly *soom* (Machilus bombycina) and *hualu* (Litsaea polyantha). The *eri* is a domesticated worm yielding a silk which cannot be reeled but has to be spun, its principal food plant being the castor plant.

There is no very accurate statistical information regarding sericulture in India, except that deducible from the sea-borne trade returns, and this must be treated with caution, as it is not always certain what the classifications adopted actually cover. From the early days of the East India Company in Bengal silk was an important article of trade. From 1776 to 1785 the export of Bengal silk to England averaged 560,285 lbs., and it is probable that this figure only covers reeled silk. Whether the industry made any great progress in the 19th century or not depends upon this point, as the total figures usually quoted from the sea-borne trade returns for the exports of Indian raw silk include not only reeled silk, but chassam, or silk waste, and silk cocoons. The exports reached their highest level in the years 1866 to 1874, when the average annual exports were 2,203,000 lbs., of which not more than 600,000 lbs. were reeled silk. The development of exports during that period is due to the work of Mr. Lister, afterwards Lord Masham, who introduced methods and machinery for spinning silk waste and created a demand for this material. In the production of one pound of silk there results from two-thirds to one pound of chassam, and the exports of this material are probably the best guide as to the total quantity of silk produced in India, though they do not include the quantity used in the two silk-spinning mills in Bombay, and do not make any allowance for the imperfect collection of chassam, which is a by-product of comparatively small value in silk reeling. To estimate, then, the Indian production of silk, we shall be fairly safe in calculating that it is at least equal to twice the export of chassam. On this assumption, the sea-borne trade statistics yield no evidence of any serious decline in the silk industry, the falling-off in the production of Bengal being fully compensated for by the expansion in Kashmir and the south of India. Taking the export figures for chassam as a guide, the Indian production of silk during the last 30 years has ranged between two million and two and a half million lbs. The exports of raw silk reached their maximum in the years 1906-07, when they averaged over 750,000 lbs., and they have fallen since to 82,700 lbs. in 1914-15, recovering in 1916-17 to 218,000 lbs. In the same year the exports of chassam and cocoons amounted to 1,325,467 lbs.

The South Indian silk industry is of comparatively modern origin; it is supposed to have been started by Tippu Sultan with seed received from China, and it is now responsible for two-thirds of the total output of silk in India. Both in Bengal and the south of India silk production is by multivoltine worms fed on the leaves of the shrub mulberry. In Kashmir, where the industry is now a State monopoly, the tree mulberry is the source of leaves, and only univoltine worms are grown. The first attempt by this State to develope the industry commenced in 1869 but, owing to the appearance of pebrine, it collapsed within ten years. In 1895 a second attempt was made which, as soon as the futility of relying upon local seed was realised, yielded successful results. Development has now reached the limit prescribed by the number of trees available for leaves, and the State derives from the monopoly a nett revenue of about 11 lakhs of rupees per annum. The output of silk is approximately 100,000 lbs. of reeled silk a year, the whole of which is exported. But the conditions under which sericulture has been developed in Kashmir are unique. Full details regarding them will be found in Mr. Lefroy's report, but they are of little value in considering the question of sericulture in British India, where conditions preclude the possibility of organising the industry on similar lines.

The following table, taken from a paper contributed by Mr. Lefroy to the Royal Society of Arts and published in March 1917, furnishes approximate figures regarding the production of mulberry silk in India in the year 1916 :—

Mysore	1,152,000 lbs.
Bengal	600,000 „
Madras	400,000 „
Kashmir	96,000 „
Burma	15,000 „
Assam	12,000 „
Punjab	1,800 „
TOTAL	2,276,800 lbs.

These figures agree very closely with the estimate of silk production based upon the exports of chassam and show clearly the very slight effect which the war has had upon the Indian silk industry. The growing prosperity of the country enables it readily to absorb large quantities of silk, and the diminished exports are probably due to the better prices obtained in India. In this connection, it is interesting to quote from a recent report on Indo-French trade by Messrs. Chadwick and Black, in which they state :—

> "Lyons is of course the great centre of silk, and regret was expressed at the almost total disappearance of Bengal silk; whereas, some years ago, Bengal silk was obtainable at 40 fr. per kilo, they now offer 70 fr. a kilo and can hardly get it. It was unrivalled for taking brilliancy, and so was almost entirely used for making the tall silk hats so popular with the last generation, but now going steadily out of fashion. It was, however, so badly reeled and prepared that it was not useful for weaving fabrics. Another house in Lyons takes most of the Kashmir silk and is very well satisfied with it. They said they had heard of so many attempts to improve the silk of the Indian plains that they were becoming doubtful whether anything permanent could be obtained."

3. There can be no question that it is desirable to make a serious attempt to improve sericulture in India. Though it can hardly be said to be flourishing anywhere, the scale of operations in Bengal and the south of India is considerable, and there is not the least doubt that its present unsatisfactory condition is due to remediable causes. The first serious attempt to deal with the problem was the employment of Mr. Maxwell Lefroy as Imperial Silk Specialist and, without presuming to endorse his conclusions on technical points, we are of opinion that his report throws much light upon the subject and should be taken as the basis for further action. In the evidence tendered to us, he has definitely stated that large tracts of India are suited for the development of raw silk production and that much of the silk, both raw and in the form of manufactured goods, now imported into India might be produced in the country. As the imports amount to more than 3½ crores of rupees per annum the matter is one of very considerable importance.

Necessity for improvement of sericulture.

4. Mr. Lefroy has proposed the establishment of an Imperial Department of Sericulture, working under the Revenue and Agriculture Department of the Government of India and provided with a suitable staff of specialists to carry on the work which, he thinks, should be undertaken. The head of the department would be the Director of Sericulture, and the future of the industry would largely depend upon his personal views; and, if the measures initiated by him happened to prove unsuited to local conditions, the consequences might be disastrous. No single expert can deal adequately with the whole question. Developments in some parts of the country will depend upon the planting of mulberry trees, which is an horticultural matter; in others, upon the turning over of land for the cultivation of mulberry shrubs and the provision of irrigation facilities. Questions of land tenure and water rights may easily become of great importance. Whether univoltine or multivoltine worms should be reared is possibly not a difficult matter to determine; but what race should be encouraged can only be settled by experts with an intimate local knowledge of the conditions of rearing. It is significant that when Mr. C. M. Hutchinson, the Imperial Agricultural Bacteriologist at Pusa, at the instance of Mr. Lefroy, examined the Pasteur method of obtaining disease-free seed by selection, he discovered that disease, in the case of flâcherie and pebrine, was not being eliminated by the methods successfully pursued in Europe, and that it was necessary to devise a modification suited to Indian conditions. It appears to us that the creation of a special Department of Sericulture would involve considerable difficulties; it would be out of touch with the numerous local interests, official and non-official, whose co-operation is needed to achieve success, and it would be unnecessarily expensive. Granted that central research and co-ordination of local efforts by advice and information are wanted, these can be secured by the employment of an imperial expert, located at a suitable centre and working under the Imperial Department of Agriculture; but the difficult work of investigating local problems and of demonstrating the results can only be successfully achieved by an agency with local interests and connections.

Criticism of Mr. Lefroy's proposals for an Imperial Department of Sericulture.

5. Unquestionably, the most important matters are the provision of arrangements for the distribution of disease-free seed and the introduction of more hygienic methods in the rearing houses. In each locality where sericulture is largely pursued a special officer will be needed to supervise such work, and he should be attached to the provincial Department of Agriculture. It seems to be more important to deal with those tracts in which sericulture is already an established industry than to introduce it into areas where, even if the climatic conditions are favourable, there may be great difficulties arising from

Improvement more important than extension of sericulture.

the prejudice of the people and their unwillingness to take up an entirely new venture.

Mr. Lefroy in his report, page 32, paragraph 12, states:—"The Mysore State is climatically the most suitable area for multivoltine silk in India and there is scope for a very large extension of this profitable industry". Also on page 38, paragraph 22:—"The only area in Madras now known to produce silk is the Kollegal taluk of the Coimbatore district, bordering on Mysore and geographically part of the Mysore plateau". Similarly, in Bengal, the history of sericulture in that province indicates the possibility that a scientific study of existing conditions may result in very great improvements of the present methods, which would make the industry more profitable and enable it to recover ground. There is, of course, no reason why efforts should not be made to introduce sericulture into other places where the natural conditions are suitable; but, in the beginning at any rate, this should only be done where it is probable that the industry will be welcomed and will expand freely as soon as it has been demonstrated as a certain addition to the resources of the people. This is a matter which may well be left to local administrations. At the outset, whether an Imperial Department of Sericulture is established, or whether the problems presented by the improvement of sericulture are dealt with in the Imperial Department of Agriculture, attention should be first concentrated upon improvement in existing areas.

Distinction between sericulture and the silk industry.

6. Sericulture may be regarded as an agricultural occupation similar to bee keeping or poultry farming. It is essentially a cottage industry, and the rearer of silkworms may or may not grow on his own land the food on which they feed. It seems unlikely that this feature will be disturbed as experience in the past is clearly against the establishment of large rearing houses.

A question of no small importance arises as to where sericulture ends and the silk industry begins. Mr. Lefroy draws no distinction between the two in regard to the organisation which he proposes should be created to deal with the silk industry in India. On the other hand, we are of opinion that a clear line of demarcation should be drawn, and that, too, at the earliest possible point. The duties of the silk rearer should end with the production of cocoons. Sericulture is, and should remain, a cottage industry; but the subsequent preparation of the silk for the market is best undertaken on a large scale and with modern machinery. The success of the Kashmir filatures is evidence in favour of this view. There is no difficulty about the marketing of silk properly reeled. Different markets require different qualities of silk, and all that is necessary is that attention should be paid to these points.

Development of sericulture.

7. The future progress of sericulture in India depends entirely on the cost of production. The profits of the industry at the present time are greatly restricted owing to the presence of disease. It has proved difficult to obtain any accurate information regarding the loss of silk from this cause; but, enquiries made in the south of India, which is possibly more favourably situated than Bengal, seem to indicate that the mere elimination of disease will at least double the output of silk. The extent to which silk can be produced is limited by the amount of food available for the worms. The price which can be paid for mulberry leaves depends upon the value of the silk produced by the worms feeding on those leaves, and if, by the elimination of disease, the quantity of silk so produced is greatly increased, it becomes possible for the rearer to pay a higher price for mulberry leaves. This will encourage the cultivation of the shrub mulberry; but, in tracts where the industry is dependent upon mulberry trees, it is very unlikely that private initiative will bring about any extended development. From five to ten years must elapse from the planting

of the mulberry tree from seed before it becomes capable of yielding a fair crop of leaves, and it is obvious that the expansion of the industry will be very precarious unless the planting of trees is fostered by Government.

Development of silk industry.

8. The development of sericulture in India will have little effect one way or the other upon the future of the manufacture of silk in India. The Indian silk weaver is already largely dependent upon China for his raw material. The steadily increasing prosperity of India has led to a proportionately greater demand for more clothing on the part of the people and for more expensive clothing among the growing number who can afford to indulge in luxuries in the way of dress. The silk weaver, even more than the cotton weaver, is in need of special technical instruction. Given this, there is hardly any doubt that he could successfully compete with the manufactured goods which are now so largely imported.

Hitherto, hand-loom weaving has been regarded almost entirely from the point of view of the weaver of cotton goods, and only incidentally have any attempts been made to assist the silk weaver. This is possibly due to the fact that the silk weaver is generally better off than the cotton weaver. The industry is in the hands of a more intelligent and wealthier class of weavers, and there is evidence to show that the increasing demand for their goods has been accompanied by corresponding attempts to improve their methods of production. Nevertheless, much more can be done to put the Indian silk weaver in a better position. This is a problem which, in the future, Departments of Industries will have seriously to tackle.

At the present time, the weakest spots in the Indian silk industry, regarded apart from sericulture, are the primitive and inefficient processes used in preparing the silk yarn. It is desirable that attention should be drawn to the necessity for improving these, and the establishment of model silk filatures, twisting mills, and dye houses seems clearly indicated. To such factories for the preparation of silk yarn silk-weaving establishments may well be attached, as it is not unlikely that the same advantages may accrue therefrom as have resulted from the addition of weaving sheds to cotton mills.

APPENDIX H.

SCIENTIFIC AND TECHNICAL SOCIETIES.

Absence of scientific and technical societies in India.

1. We desire to attract attention to the almost complete absence of scientific and technical societies in India. So long as the majority of the men in this country from whom such societies would naturally draw their members belonged to Government executive services, the subordination essential to discipline was unfavourable to their inception and growth; but this phase is gradually passing away, owing to the much wider diffusion of scientific knowledge, to the rapid expansion of organised industries, and to the greatly increased number of scientific and technical experts in private employment.

In the past, the scientific and technical services were recruited at home, and not a few of their members belonged to the great English societies, which have been formed to promote the interests of special branches of science and technology. As an example, we may cite the Public Works Department. It has a long record of magnificent achievements to the credit of its officers, and their contributions to scientific and engineering literature are found in the journals of many societies, notably the Proceedings of the Institution of Civil Engineers. It has undertaken extensive researches to solve special problems connected with Indian engineering, and from time to time efforts have been made to issue a regular series of professional papers; but for one reason or another, the supply of suitable material has after a time ceased. Only to a very limited extent is it possible for trade and technical journals to serve as *media* for the publication of professional and scientific work. No prestige attaches to original communications offered to the world in this way, and the ephemeral character of these journals militates against their permanent preservation. Hitherto, therefore, the bulk of the original work done in India has been published in the transactions or proceedings of English societies. There is, however, a limit to the possibilities of this and the history of much work of more than transient or Indian interest is buried in the records of Government departments.

In Great Britain the volume of research work, enquiry and practical experience has increased so rapidly, and specialisation has developed to such an extent, that it has become necessary, at frequent intervals, to establish new institutes or new societies to deal with the new groups of problems which have arisen. The members in the larger societies have also increased so greatly in numbers and they are so widely scattered that they have had to form themselves into branch associations, to attend more especially to matters of local interest.

It is unnecessary for us to dwell at any length upon the advantages which arise from a free interchange of ideas between men working in the same field of scientific investigation, and the stimulating effect of instructed criticism on men engaged in technical pursuits.

Necessity for the establishment of certain societies in India.

2. We are of opinion that the interests of India demand the establishment of Indian institutes, societies and associations analogous to the Institution of Civil Engineers, the Chemical Society, and the British Association for the Advancement of Science. Action in this direction is urgently required to provide for the growing needs of Indians. It is true that they have free access to the English societies on the same terms as any other subjects of the

Empire, and they are also freely admitted to American societies; but beyond the prestige attaching to membership and the periodic receipt of copies of publications, they derive little or no benefit from such distant associations, and they are altogether deprived of the advantages which arise from personal intercourse between the members. In matters connected with administration, the value of personal discussion has been recognised by Government, and every year an increasing number of conferences and committees meet to discuss specific problems. Men are convoked from all parts of India to exchange views, and experience shows that such meetings are well worth the time devoted to them and the expense incurred in bringing the officers together. But something more than this is necessary, and the movement in favour of it has found expression in the establishment of the Indian Science Congress, which was started four years ago and holds annual meetings in the month of January in one or other of the capital cities of India. Government supports it by the grant of travelling allowances to selected scientific officers attending its meetings, and the Congress is doing useful work and is stimulating the growth of conditions favourable to the prosecution of research in a great variety of directions.

Proposals for an Indian Institution of Engineers.

3. Some attempt also has been made, with an encouraging degree of success, to establish local and specialised associations. The principal mining interests of India are centred in Calcutta, which is at no great distance from the Bengal coal fields, and in 1906, with the help of the Inspectors of Mines and officers of the Geological Survey, the Mining and Geological Institute of India was founded "to promote the study of all branches of mining methods and of mineral occurrences in India, with a view to disseminating the information obtained for facilitating the economic development of the mineral industries in the country." It now includes among its members a large proportion of the mining engineers working in Bengal and, to a less extent, those engaged in other parts of India. Calcutta is also the largest centre of mechanical engineering in India, and the resident members of the Institution of Mechanical Engineers, London, have formed a local branch under the standing rules framed by the parent society. The members meet from time to time to read and discuss papers and, as a purely local body, it has met with some success; but it has not sufficient prestige to attract many members from other parts of India. This points to the necessity for a wider basis of membership and a broader field of common interests which, we think, would be found in an Indian Institution of Engineers embracing all the branches of engineering practised in India. The majority of engineers are in the service of Government; but the number of those not so employed is considerable and is likely to increase rapidly in the future with the development of industries. In a country like England, where engineers are very numerous, clearly marked divisions have naturally arisen, and when the interests of any section have become of sufficient importance, a specialised association has been established to promote them. In India the total number of engineers is still too small to permit of this subdivision with advantage; and all that seems possible at the outset is to establish an institution for the profession as a whole. The same gradual process of evolution as in England may be anticipated, and when any special branch has become strong enough, it will probably follow the same course.

4. From such enquiries as we have been able to make, we consider that a satisfactory precedent would be found in the English Institution of Mechanical Engineers, which has its headquarters in London with a number of provincial branches, and annually holds a summer meeting in one or other of the large provincial centres of engineering; whilst it also occasionally fraternises with

similar societies on the Continent. Papers prepared for the Institution are read and discussed at meetings of the members held nearly simultaneously in London and in any of the provincial centres where they are likely to be of interest. The same thing could very well be done in India. There would be great advantages arising from a strong central society covering the whole of India, as membership thereof would confer a much greater prestige. Apart from the reading and discussion of professional papers, such a society would inevitably interest itself in many problems with which the State has to deal, and in which it would be advantageous to obtain the considered opinion of such a representative body. Many such matters have come before us in the course of our enquiries, among which we may mention the education and training of engineers, the necessity of certificated attendants on boilers, the working of the Acts affecting the engineering profession, and the grant of concessions in respect of mining rights or water power. Such an institution should be an entirely independent body, to which Government might very well make an annual grant or subsidy in return for the indirect advantages which the country would enjoy in consequence of its establishment. We have in view an institution whose activities would be mainly devoted to professional and technical questions; its existence therefore would be of great value in establishing a standard of professional conduct and efficiency. Almost every civilised country in the world has an engineering association of some kind, and we think that India should no longer be deprived of the advantages accruing therefrom. But the conditions in this country are unique, and it seems hardly likely that a successful institution of engineers could be established without encouragement and some pecuniary assistance from Government.

APPENDIX I.

STATISTICAL EVIDENCE REGARDING THE DEVELOPMENT OF HAND-LOOM WEAVING IN INDIA.

Three causes have contributed to the existing general impression that hand weaving in India is a declining industry. They are (1) the enormous increase in the production of mill-made cloth; (2) the bad financial conditions under which the hand weavers work, and especially the extent to which they have had to receive famine relief; and (3) the census figures. The second reason, which has been discussed in the body of the report, is undoubtedly a corollary of the first, which is an evident fact. This note will, therefore, deal mainly with the third factor, *viz.*, the census figures.

2. In paragraphs 91 and 92 of the Madras Census Report for 1911, Mr. Chatterton has examined the figures and concludes that there has been little, if any, diminution in the number of weavers in that province. The passage in question is as follows:—

> "91. The condition of hand-loom weavers is generally assumed to have steadily deteriorated owing to the effect of competition, and of indirect evidence there is plenty in support of this idea. The weavers themselves complain that their condition has steadily become worse, that they have to work harder and that now the coarse weavers, even by the most unremitting toil, are only able to make a bare livelihood. The present census is the fifth that has been taken, and if the classification of the returns had been uniform throughout, it would have been possible to state definitely whether the number of weavers was increasing or decreasing; but unfortunately there have been many changes in the methods of grouping trades or branches of a trade at each census, and it is difficult to arrive at any certain conclusion. The following tabular statement has been compiled to show what comparable returns are available since 1871 regarding those employed in the more important branches of the cotton trade:—

——	—	1871.		1881.		1891.		1901.		1911.	
Cotton-ginning, cleaning and pressing.	Mill	...	24,714	...	...	...	15,041	1,961	12,643	1,824	20,067
	Hand	24,714				15,041		10,682		18,243	
Cotton manufactures	...	...	...	...	188,157	...	...	...	...	...	...
Cotton-spinning and weaving.	Mill	...	...	...	...	...	7,306	6,851	6,851	16,615	16,615
Spinners	Hand	...	...	...	...	7,306		6,414	6,414	...	368,509
Weavers	Hand	...	376,561	...	196,610	...	365,112	...	383,132	...	

> "92. From an examination of this table, it is clear that in 1871, there were 376,561 weavers (males) but in 1881, 188,157 males are returned as cotton manufacturers, and the weavers only number 196,610. The total comes to 384,767, and probably includes cotton ginners and cotton spinners. We may assume approximately that these numbered about 20,000 and that, therefore, the number of weavers in 1881 was slightly over 360,000 showing a probable decrease of 15,000 weavers in the 10 years. This result would not be unexpected remembering the havoc caused by the great famine of 1877. In 1891 the weavers are returned as 365,112 and in,

1901 as 383,132. So far as can be ascertained these numbers are comparable, and would show a slight increase in the actual number of weavers. The figures for 1911 are reported as 385,124, but this includes all mill hands and persons engaged in power factories connected with spinning and weaving. The number of these latter is 16,615, and deducting these, we obtain that the number of hand weavers in 1911 is 368,509. I think, therefore, we may safely accept the following conclusion:—That in the last forty years the number of hand-loom weavers has remained practically stationary, but that owing to stress of competition they now turn out a larger amount of finished goods than was formerly the case; that is to say, the majority of them have to work harder to make a bare living. One might also add that their lot would probably be greatly improved if they could be induced to accept outside assistance, which can only be effectively rendered by the establishment of small hand-loom weaving factories. The individual weaver suffers because he is still trying to carry on a complex series of operations without recognition of the advantages of subdivision of labour."

3. The conditions of the Madras hand-loom industry are, however, in some respects peculiar. The proportion of fine weaving is higher than in most other provinces; the industry is more concentrated in localities, and it relies to some extent on a regular export trade in certain special lines.

It is necessary to examine the position of other provinces of India, where equally favourable circumstances do not exist. The difficulties and uncertainties arising from the manner in which occupations have been recorded at the different censuses are considerable. Owing to lack of homogeneity among the systems employed in the earlier censuses, figures have had to be selected carefully and no general and complete presentment of the case is possible. We may examine, in the first instance, the figures from 1891, for various branches of the cotton industry in Bengal, Bombay, the United Provinces, the Central Provinces (excluding Berar), and the Punjab (including the North-West Frontier Province). The figures are in all cases taken for British India only, in order to eliminate the possibilities of error arising from the less efficient management of the earlier censuses in Native States:—

Totals of Bengal, Bombay, United Provinces, Central Provinces (excluding Berar) and the Punjab (including the North-West Frontier Province).

—			Workers.	Total workers and dependents.
Cotton ginning, pressing and cleaning.	1891		......	455,644
	1901	Hand workers	136,495	306,929
	1911	. . . .	122,293	255,030
Spinning, sizing, weaving and yarn beating.				
	1891	Factory hands	......	133,461
		Spinners, etc.	......	725,751
		Weavers	......	3,478,531
		Total hand workers		4,204,282

Totals of Bengal, Bombay, United Provinces, Central Provinces (excluding Berar), and the Punjab (including the North-West Frontier Province).—contd.

—			Workers.	Total workers and dependents.
Spinning, sizing, weaving and yarn beating.—*contd.*	1901	Mills	137,675	246,194
		Hand weaving	1,482,086	3,173,855
		Spinners, sizers, and beaters.	291,636	417,037
		Total hand workers	1,773,722	3,590,892
	1911	Ginning, pressing and cleaning.	122,293	255,030
		Ginning, pressing and cleaning factories.	46,937	......
		Nett hand workers	75,356	......
		Spinning and weaving.	1,500,662	3,012,601
		Spinning and weaving factories.	204,476	......
		Nett hand workers	1,296,186	......

NOTE.—(1) In the Central Provinces (excluding Berar) where separate figures are given for spinners and weavers in 1911, working spinners are 14 per cent. and total spinners (workers and dependents) 11 per cent. respectively on workers and total of spinners, weavers and sizers. If this ratio be assumed all through, hand weavers in 1911 for the total of the provinces selected would be as under:—

Workers	1,290,569
Total workers and dependents	2,681,215

(from which factory workers 204,476 and their dependents must be deducted).

(2) Even in 1911, hand and factory textile workers were not recorded separately; the latter were enumerated at a separate and subsequent industrial census with the result that dependents are not shown and there is no basis of comparison.

The following comparison may now be made:—

	Total workers and dependents.	Workers.
1891	3,478,531	(separate figures not available.)
1901	3,173,855	1,482,086
1911	2,681,215*	1,290,569

* from which factory workers 204,476 and their dependents must be deducted.

For 1881 we have the following figures:—

	Males.	Females.	Total.
Workers in cotton and flax—	1,642,429	...	...

Figures for females, and totals for the United Provinces are unfortunately not available. But if the average proportion existing in other provinces is also taken for the United Provinces, the totals would be:—

Males.	Females.	Total.
1,642,429	1,886,447	3,528,876

The above figures were apparently inclusive of the following number of weavers :—

	Males.	Females.	Total.
Bengal	361,739	100,211	461,950
Bombay	...	...	224,343
United Provinces	367,774	...	...
Central Provinces	(Not available).		
Punjab	286,523	91,136	377,659

Assuming that the males only were workers, the above figures compare with the totals in subsequent years for hand weavers in the United Provinces, Bengal and Punjab.

1881	1,016,036	Workers (males).
1891	2,750,117	Total workers and dependents.
1901	1,170,808	Workers (males and females).
1911	839,349	Workers (by applying C. P. formula for deducing spinners).

In order to take the figures back to 1872, we must confine ourselves to Bengal and the United Provinces the totals for which were :—

1872	590,702	Workers (males).
1881	729,511	
1891	1,828,616	(Total workers and dependents).
1901	837,731	Workers.
	1,849,855	(Total workers and dependents).
*1911	538,189	Workers.
	1,155,272	(Total workers and dependents—from which factory workers 23,693 and their dependents must be deducted).

5. We may check these results by pursuing a parallel line of enquiry and comparing the totals of all workers and dependents in the weaving industry in the only province for which figures are available, *viz.*, Bengal :—

1872	291,590	(apparently only actual workers).
1881	461,950.	
1891	923,986	
1901	901,982	
1911	458,762	(includes spinners).

The figures for several provinces are available from 1881, *viz.*, Bengal, Bombay and Punjab; the totals (workers and dependents) for these are given below :—

1881 . . .	1,063,952	
1891 . . .	2,139,996	
1901 . . .	1,947,574	
1911 . . .	1,897,191	(from which factory workers 178,047 and their dependents must be deducted).

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* Figures for spinners deduced as above.

The uncertainty of these figures may be conjectured from the following comparison :—

—	Bombay.	Bengal.
1872	73,015	291,590
1881	224,343	461,950
1891	294,509	923,986
1901	227,303 (+ 168,043 for factories.)	901,982 (+ 7,829 for factories).
1911	614,214	458,762†

† (includes spinners) from which factory workers 164,069 and 10,838 respectively and their dependents must be deducted.

It is clear that considerable differences of method seem to have existed in bygone censuses in deciding what persons should be recorded as weavers by occupation.

6. A few figures are available regarding the extent to which weaving castes are actually working as weavers. Only those cases have been chosen in which figures appear reliable.

Bengal *Jogi*—

	Males.	Females.
Workers in all occupations—		
1911	101,179	18,055
1901	76,738	13,480
Working as weavers—		
1911	32,676	10,352
1901	39,633	8,980

NOTE.—Figures for 1901 include certain occupations allied to weaving.

Tanti and Tatwa—

	Males.	Females.
Workers in all occupations—		
1911	99,034	26,074
1901	226,999	87,897
Working as weavers—		
1911	42,178	9,109
1901	90,025	30,403

There seems some doubt if *Tatwas* are included in the 1911 figures; but the proportion of the total workers working as weavers in each year is worth noting.

		Per cent.
Males	1911	42
	1901	39
Females	1911	34
	1901	34

Central Provinces *Balahi* (very coarse weavers).

Workers in all occupations—

1911	32,480
1901	28,036

Working as weavers—

1911	2,009
1901	12,388

Kori (medium weavers).

Workers in all occupations—

1911	18,745
1901	18,821

Working as weavers—

1911	7,415
1901	7,246

Koshti (fine weavers).

Workers in all occupations—

1911	85,522
1901	84,551

Working as weavers—

1911	68,767 (including 32,217 females).
1901	36,699

It looks as if a different criterion had been applied to decide what constitutes a female weaver in 1911 from that adopted in 1901, and thereby some doubt is thrown on the figures for other castes than the above.

Mahar (coarse weavers)—

Workers in all occupations—

1911	752,457
1901	410,471

Working as weavers—

1911	83,773
1901	89,406

Panka (very coarse weavers)—

Workers in all occupations—

1911	82,627
1901	93,691

Working as weavers—

1911	10,486
1901	20,471

7. The figures seem very doubtful. It is clear that, apart from lack of homogeneity and other causes, there has been an absence of agreement as to the point where the line should be drawn between weaving castes working as weavers and working at other occupations, *e.g.*, cultivation; and it also seems likely that females helping their husbands by reeling, sizing, etc., are sometimes recorded as weavers, sometimes as sizers and sometimes as dependents. Again the famines of 1897-1900 compelled changes of occupation in many cases, especially among the coarse weavers, which may or may not become permanent. The following conclusion may, however, be drawn, though only with caution and reserve. There has been some apparent tendency for the total number of weavers to decrease; but there is reason to believe that this

reduction, so far as it is real, is confined mainly, if not wholly, to the coarse weavers, who are often not whole-time weavers, whose products are less specialised and more exposed to mill competition and who find it more easy to take to unskilled labour.

Attempts at any form of industrial census are rare in India; but an enquiry made into the number of looms in certain districts in Madras in 1913-15, as compared with the results of an enumeration of looms made in 1900 for the Madras Statistical Atlas, shows, if the figures are to be relied on, an increase of 69 per cent. over the latter total.

8. We may now consider the figures for the consumption of yarn by hand weavers. If we take the imports and internal production of yarn in mills, and deduct from these the exports and the quantity of yarn corresponding to the quantity of cloth produced in mills, we shall obtain a figure showing the balance of mill yarn not woven into cloth or exported, and therefore, allowing for the small quantity made into such articles as rope, tape, etc., wholly or almost entirely used by hand weavers. At present the quantity of hand-made yarn woven by hand weavers is negligible. It was almost certainly very small in the former of the two periods taken in the statement below (Statement I), and is not enough to account for the difference revealed by the comparison between the two periods. The inference, therefore, is that there has probably been a small increase in the amount of yarn woven since the period 1896-97 to 1901-02; and it is precisely since that period that the decline in weavers exhibited by the census figures is apparently largest and most certain. If the figures for yarn production are correct, it follows that either the census figures do not correctly exhibit the actual state of affairs, which is highly probable on other grounds, as we have seen, or that the remaining weavers have been more actively employed. But, in any case, we may fairly conclude that there has been no general falling off in the employment of hand weavers. This conclusion does not conflict with that reached by Mr. Chatterton in the case of Madras.

9. In order to eliminate, as far as possible, the effect of the famine years of 1896-97, 1899-1900 and 1900-01 in reducing the production of the basic period, and thereby vitiating to some extent the comparison, a further statement, (Statement II), based on figures supplied by Sir B. D. Mehta, of the Empress Mills, Nagpur, has been added, showing the production, consumption, exports and imports of yarn, year by year, since the figures for mill production have been recorded. An extract (Statement III) from a letter by the same gentleman, giving his views on the subject, is also appended.

10. The position of the weaver cannot, however, be estimated solely from the weight of yarn which he converts into cloth. On yarn of fine counts he expends a very much larger amount of labour per lb. of material used than on coarse yarn. For instance, in the manufacture of a turban cloth made of 100's counts 1·3 lbs. of yarn were used which cost Rs. 3-4-0, the labour charges came to Rs. 5-8-0 equivalent to Rs. 4-3-8 per lb. of yarn, whilst in the manufacture of cloth from 20's counts 3½ lbs. of yarn costing Rs. 2-0-0 were used, and the labour charges amounted to Re. 1-9-0 or slightly over annas 7 per lb. These examples are extreme cases and an intermediate example of a dhoti made from 60's counts may be cited. The cost of the yarn was Re. 1-8-0 per lb. and the cost of the labour Re. 1-2-4 per lb.

11. Statement IV shows in tabular form the imports of yarn from 1890 to 1914. For the first 5 years of the period they averaged 44·78 millions of lbs. per annum, whilst during the last five years ending 1913-14 they averaged 41·79 millions of lbs. per annum. In the 5 years 1900-1905, consequent upon the effects of famine, the average imports were only 33·07 millions of lbs. per annum. The figures however require examination in detail, and the information available is tabulated in Statement V, which gives averages for 5 year

periods from 1899-00 to the end of 1913-14; these show that while the imports of coloured yarn are steadily decreasing in respect of the lower counts, there has been a very marked rise in the imports of grey yarn of counts over 40's. From 41's to 50's the average increase is 119 per cent. and over 50's it is 95 per cent. Up to the outbreak of the war, then, there is definite evidence to show that the weavers of India were not only using more yarn but that, so far as imports were concerned, there was a very marked increase in the consumption of fine counts.

12. Corroborative evidence regarding the vitality of the hand-loom industry is furnished by Statement VI which gives the number of handkerchiefs and shawls exported from India from 1890 to 1914. Although the variations from year to year are very considerable, there was no marked change in the trade till about 1904, since which date there has been a distinct upward tendency, so that the last 5 years' exports show an average increase of 27 per cent. over the average of the 10 years 1894-1904.

13. As we have seen, the evidence regarding the number of hand-loom weavers in India yielded by the census returns is of little value, but there is no uncertainty as to the facts deduced from the trade statistics, which clearly indicate that the consumption of yarn is increasing and that it is most marked in respect of fine counts. We may, therefore, conclude that the hand-loom industry is at present holding its own, and that there is good reason to suppose that the universal adoption of technical improvements such as warping mills, fly-shuttle slays and jacquard harness would greatly enhance the material prosperity of the largest group of artisans in the country.

STATEMENT I.

—		Average of 1896-97—1901-02.	Average of 1908-09—1913-14.
		lbs.	lbs.
1. Yarn imported	by sea	44,955,812	41,748,910
	by land	1,008	79,744
2. Yarn made in Indian mills		473,000,044	648,559,400
Total		517,956,864	690,388,054
3. Yarn* exported	by sea	209,397,927	200,831,400
	by land	7,610,064	14,631,904
Total exports		217,007,991	215,463,304
4. Nett (quantity available in India)		300,948,873	474,924,750
5. Cloth made in Indian mills†		98,728,909	248,917,909
6. Equal to yarn‡		88,150,812	222,248,133
7. Yarn (mill-made) available for hand-loom weavers (Col. 4 *minus* Col. 6)		212,798,061	252,676,617

* Including Re-export.

† All woven goods.

‡ Calculated at the rate of 100 lbs. yarn = 112 lbs. cloth.

STATEMENT II.

Statistics of production and distribution of—

(*a*) Cotton yarn manufactured in Indian mills.
(*b*) Cotton yarn imported.

(In crores of pounds.)

Official year.	Production of yarn in Indian mills.	Imports of yarn.	Total yarn available, columns 2 and 3.	Production of cloth in Indian mills.	Mill consumption of yarn ($\frac{25}{28}$ of column 5).	Exports of yarn including re-exports of imported yarn.	Total mill consumption and exports, columns 6 and 7.	Balance available for hand looms, column 4 *minus* column 8.
1	2	3	4	5	6	7	8	9
1895-96	43·24	4·64	47·88	...*	...	18·55	...	...
1896-97	42·32	5·02	47·34	8·29	7·40	19·74	27·14	20·20
1897-98	46·26	5·83	52·09	9·13	8·15	20·17	28·32	23·77
1898-99	51·24	4·55	55·79	10·17	9·08	22·12	31·20	24·59
1899-00	51·39	4·26	55·65	9·81	8·76	24·26	33·02	22·63
1900-01	35·30	3·48	38·78	9·87	8·81	11·93	20·74	18·04
Average .	45·30	4·63	49·93	9·45	8·44	19·64	28·08	21·85
1901-02	57·29	3·83	61·12	11·97	10·69	27·42	38·11	23·01
1902-03	57·57	3·37	60·94	12·26	10·95	25·00	35·95	24·99
1903-04	57·88	2·80	60·68	13·80	12·32	25·36	37·68	23·00
1904-05	57·84	3·06	60·90	15·87	14·17	24·92	39·09	21·81
1905-06	68·09	4·58	72·67	16·39	14·63	29·85	44·48	28·19
Average .	59·73	3·53	63·26	14·06	12·55	26·51	39·06	24·20

* Production statistics available only for February and March 1896.

STATEMENT II—*concld.*

(In crores of pounds.)

Official year.	Production of yarn in Indian mills.	Imports of yarn.	Total yarn available, columns 2 and 3.	Production of cloth in Indian mills.	Mill consumption of yarn ($\frac{25}{28}$ of column 5).	Exports of yarn including re-exports of imported yarn.	Total mill consumption and exports, columns 6 and 7.	Balance available for hand looms, column 4 *minus* column 8.
1	2	3	4	5	6	7	8	9
1906-07	65·37	3·77	69·14	16·58	14·80	24·43	39·23	29·91
1907-08	63·83	3·73	67·56	18·91	16·88	21·67	38·55	29·01
1908-09	65·76	4·15	69·91	19·24	17·18	23·61	40·79	29·12
1909-10	62·76	4·03	66·79	22·88	20·43	22·84	43·27	23·52
1910-11	60·69	3·25	64·24	24·58	21·95	18·44	40·39	23·85
Average .	63·74	3·79	67·53	20·44	18·25	22·20	40·45	27·08
1911-12	62·50	4·20	66·70	26·66	23·80	15·23	39·03	27·67
1912-13	68·85	5·00	73·85	28·55	25·49	20·47	45·96	27·89
1913-14	68·28	4·42	72·70	27·44	24·50	19·89	44·39	28·31
1914-15	65·19	4·29	69·48	27·70	24·73	13·43	38·16	31·32
1915-16	72·24	4·04	76·28	35·22	31·45	16·10	47·55	28·73
Average .	67·41	4·39	71·80	29·11	25·99	17·02	43·01	28·79

STATEMENT III.

Extract from a letter dated 18th April 1917 from Sir B. D. Mehta of the Empress Mills, Nagpur.

I enclose a memorandum from which you will see the Mill-Owners' Association would appear to assume the weight of yarn to be increased by 12 per cent. in weaving. The increase, as you know, is due to the extra weight added in the sizing and finishing processes. The percentage assumed by the Mill-Owners' Association must be an empirical one, as the exact additional weight depends on the quality of every description of cloth. However, coming, as it does, from such an authority, it may be taken as a roughly correct approximation. I also send another statement prepared from the statistics appearing in the Mill-Owners' Association Report, which I send you for what it is worth in connection with the investigation you are after. It seems the consumption of hand looms has, at all events, not decreased during the last twenty years; rather it is very slightly the other way. Of course the consumption by power looms has expanded by leaps and bounds, but this has been made up by the increased production of yarns *plus* diminution of exports to China.

It is very likely hand-spun yarns were used in fair quantities on hand looms 20 or 25 years ago. The hand-spinning industry is now practically extinct.

MEMORANDUM.

The Annual Reports of the Bombay Mill-Owners' Association give statistics of the production and distribution of cotton yarns manufactured in Indian mills. The following is an extract from the Report for 1916:—

> "The quantity of yarn produced in India during the official year 1915-16 amounted to 722,424,579 lbs. Of this amount, 314,512,996 lbs. were consumed in the production of 352,254,556 lbs. of cloth and 160,231,736 lbs. exported to foreign countries during the official year 1915-16, leaving a balance of 247,679,847 lbs."

The Association assumes in the above that every 100 lbs. of yarn used in weaving give out a cloth production of 112 lbs. Accepting this authority, the factor for turning cloth into yarn is $\frac{100}{112}$ or $\frac{25}{28}$, *i.e.*, multiply the weight of cloth in pounds by 25 and divide by 28, and you get the weight of the yarn which goes to the making of that cloth.

The balance of yarn left after deducting the quantities exported and consumed by mills is not all consumed by hand weavers. A small proportion of this must be used for making rope, twine, etc. In a paper, which he read before the First Indian Industrial Conference of 1905, Sir Vithaldas Thackersay estimates this proportion to be about 10 per cent. of the balance. The remainder of course must ultimately find its way to hand looms.

STATEMENT IV.

Imports.

Total Cotton Twist and yarn—

	Quantity.	Value.
	lbs.	Rs.
1890-91	50,970,950	3,76,83,624
1891-92	50,404,318	3,51,46,195
1892-93	38,276,545	2,68,38,496
1893-94	42,806,991	3,10,89,407
1894-95	41,482,847	2,85,12,542
1895-96	46,354,766	2,97,10,904
1896-97	50,173,890	3,32,58,708
1897-98	58,290,717	3,49,30,384
1898-99	45,545,668	2,55,16,342
1899-00	42,621,854	2,45,00,108
1900-01	34,803,334	2,48,92,147
1901-02	38,299,409	2,64,70,267
1902-03	33,681,300	2,29,75,871
1903-04	28,016,565	2,14,20,756
1904-05	30,575,855	2,48,76,477
1905-06	45,776,742	3,42,53,987
1906-07	37,673,288	3,22,31,592
1907-08	37,315,737	3,69,32,448
1908-09	41,524,055	3,64,88,312
1909-10	40,300,460	3,31,95,673
1910-11	32,503,657	3,13,72,555
1911-12	41,958,910	3,79,07,055
1912-13	50,035,210	4,44,74,655
1913-14	44,171,167	4,16,42,445

STATEMENT V.

	Grey.			Coloured.		
	1899-00 to 1903-04.	1904-05 to 1908-09.	1909-10 to 1913-14.	1899-00 to 1903-04.	1904-05 to 1908-09.	1909-10 to 1913-14.
Average of Imports of 1-10's. . .	137,858	163,673	114,649	1,885,145	1,153,983	794,235
,, ,, 11-15's. . .	115,837	64,062	93,618			
,, ,, 16-20's. . .	298,695	460,958	372,741			
,, ,, 21-25's. . .	29,653	52,324	152,307	1,658,985	1,107,739	847,309
,, ,, 26-30's. . .	2,765,031	2,587,154	2,544,808	997,298	1,035,055	829,399
,, ,, 31-40's. . .	8,215,444	9,070,880	9,214,832	12,736,034	13,092,257	13,997,879
,, ,, 41-50's. . .	1,108,668	1,800,201	2,429,033	763,307	902,248	589,161
,, ,, above 50's. . .	1,871,725	2,938,292	3,664,064	673,899	1,034,231	919,912

N.B.—The figures are in pounds.

STATEMENT VI.

Exports of Indian Merchandise.

Handkerchiefs and shawls in the piece—

	Numbers.	
1890-91	1,868,988	
1891-92	1,938,177	
1892-93	1,031,439	
1893-94	997,202	
1894-95	1,232,989	1,633,923 Average.
1895-96	1,464,214	
1896-97	2,058,431	
1897-98	1,760,112	
1898-99	1,653,867	
1899-00	1,275,384	1,591,311 Average.
1900-01	1,424,161	
1901-02	1,741,727	
1902-03	1,744,678	
1903-04	1,770,605	
1904-05	2,613,138	1,985,014 Average.
1905-06	1,892,602	
1906-07	1,179,586	
1907-08	2,115,582	
1908-09	2,124,161	
1909-10	1,886,370	2,044,759 Average.
1910-11	2,124,495	
1911-12	2,868,852	
1912-13	1,949,550	
1913-14	1,394,532	

APPENDIX J.

MEMORANDUM ON THE DEPARTMENT OF INDUSTRIES IN THE MADRAS PRESIDENCY.

Early History

In December 1897 the Superintendent of the School of Arts in Madras fell ill, and Mr. A. Chatterton, who was then Professor of Engineering at the Engineering College, was placed in charge of the school. Mr. Chatterton, who had already devoted much time to the question, obtained a small grant from Government in the beginning of 1898 for experiments in the manufacture of aluminium vessels in the School of Arts, and, by August 1899, so much progress had been made in the introduction and development of the industry that the Government applied to the Secretary of State for permission to employ Mr. Chatterton for a term of three years in furthering the progress of technical and industrial education in the Madras Presidency. It was further proposed that he should devote himself to the restoration, organisation and development of those technical trades and industries, especially metal work and connected arts, which appeared most likely to prove successful, and that he should pay special attention to the following matters :—

(1) The development of the aluminium industry ;
(2) the inspection and reorganisation of existing industrial schools and the establishment of new ones ;
(3) the development of indigenous industries ; and
(4) the establishment of a manual training class in the College of Engineering workshops or elsewhere.

The Government of India recommended these proposals for sanction, subject to the remark that too much had been done in the way of the commercial development of the aluminium industry ; but the Secretary of State sanctioned the proposals, merely remarking that he noted that the aluminium industry would be left to private enterprise as soon as the success of the industry was assured, and that trade would benefit by the methods which had been adopted under Government supervision. The date of this despatch was 15th February 1900, and it may be noted that when it was written, the aluminium department of the School of Arts was already working on a considerable commercial scale, its sale receipts in the year 1898-99 having amounted to Rs. 44,621, while in the year 1899-1900 they rose to Rs. 91,432. It is evident, therefore, that in 1900 the Secretary of State had no objection to the working of pioneer industries by Government on a commercial scale, provided that, as soon as their success was assured, they were handed over to private enterprise.

2. The aluminium industry, together with his work as Superintendent of the School of Arts, occupied the greater part of Mr. Chatterton's time during the term of his special duty, but the period was also marked by the inception of experiments with hand-loom weaving, with oil engines and centrifugal pumps for lift irrigation and with chrome tanning. Consequently, when Mr. Chatterton went on leave in 1904, he was deputed to make enquiries into the American system of well irrigation, the possibility of introducing an improved pump for irrigation purposes, the possibility of introducing warping and sizing machinery suitable for the weaving industry of the Presidency, and the methods of chrome tanning as practised in America. On return from leave, he was again placed on special duty for the purpose of exploiting and developing

technical trades and industries in the Presidency. He was entrusted with the direction of industrial education and technical education, in so far as it was connected with the exploitation of industries, and with the superintendence of experiments in irrigation and pumping. His special instructions were first to devote particular attention to the development of irrigation by pumping and to the encouragement of the chrome-tanning and weaving industries. As Inspector of Technical Schools and of the School of Arts, he was placed under the Director of Public Instruction, and in regard to his other work he was subject to the control of the Board of Revenue.

Department of Industrial and Technical Enquiries.

3. These orders were passed in March 1905, but at the same time Government had a more important scheme under contemplation. Hitherto, Mr. Chatterton had been on special duty, and the temporary nature of his appointment prejudiced the development of his work on a stable and orderly basis. Consequently, later on in 1905, a step in advance was taken, and a scheme was submitted to the Government of India for the further advancement of the industrial development of the Presidency. To that end it was proposed to create a department which should make a survey of existing industries and should investigate the possibility of creating new ones. It was not proposed to work industries experimentally on a commercial scale, but merely to initiate experiments which might assist private enterprise to take up fresh industrial undertakings. It was also proposed to establish a bureau where the best available advice on industrial methods might be obtained. By this time Lord Morley had become Secretary of State for India, and, in view of subsequent developments, it is not surprising that he did not view the general principles underlying the scheme with much favour. He regarded with scepticism the prospect of attaining satisfactory results from the direction of State effort towards the creation of industries, and he doubted whether the lack of industrial energy and progress in the Madras Presidency might not be due to economic causes beyond the reach of State endeavour. However, by way of experiment, he sanctioned the creation of the new department and the appointment of Mr. Chatterton to the charge of it, with the title of Director of Industrial and Technical Enquiries. Thus the Department of Industries came into existence in August 1906, though not under that name, and in the following year, it was strengthened by the appointment of an Assistant Director, in the person of a junior Engineer of the Public Works Department. The work consisted largely of chrome tanning and investigations into the hand-loom weaving industry, but experiments in other directions were also carried on. Boring operations were begun, and it was shown that in certain districts of the Presidency considerable supplies, often artesian or semi-artesian in character, of subterranean water existed. And, by encouraging the installation of pumps driven by internal combustion engines, it was proved that these and other supplies of water could profitably be used for irrigation.

Industrial Conference.

4. In September 1908 an Industrial Conference was held at Ootacamund, the representatives of the leading industrial interests being invited to attend. The object of the Conference was to consider the best method of developing further the work which had been begun by the Director of Industrial and Technical Enquiries, and also to review the question of the improvement and extension of technical education. Sixty-eight resolutions were passed by the Conference under the heads (1) Industrial development, (2) Technical education, (3) Textiles and dyeing, (4) Sugar, chemicals and leather, and (5) other industries. The Conference defined the three functions of the Department of Industries as (1) the supply of advice in regard to new industries, and the introduction of new methods and processes, (2) the carrying out of investigations and

experiments, and (3) the development of selected industries, and added that the department should open a bureau of information and an industrial museum. And in regard to the vexed question of pioneer industries, the Conference passed the following resolution :—

> "The Government may undertake, as a pioneer, the introduction of new industries or industrial processes for the purpose of training students or apprentices or for demonstrating that such industries will be commercially successful.
>
> "Provided—
>
> "(1) that no such undertakings be engaged in without prior consultation with an Advisory Board, upon which Indian interests and the leading commercial and trading interests in the Presidency should be represented;
>
> "(2) that no such undertaking, if used for demonstrating any process as commercially successful, should be engaged in, unless, after careful enquiry, the Government arrives at the conclusion that it is one in which the private capitalist does not already exist nor is willing to venture;
>
> "(3) that it should be a principle of such undertakings that the fullest possible publicity should be given by the periodical publication of reports and by a full statement of the accounts of the undertakings; and
>
> "(4) that, looking to the principle that such undertakings, if used for demonstrating that any process is commercially successful, should be directed to the assistance of private enterprise, it should be a rule that Government should withdraw from any such undertaking as soon as it is clear that it has sufficiently demonstrated the advantage of the improved methods of working in that particular industry."

5. These resolutions, however, were not passed without protest. The operations of the chrome-tanning department, the sales in which in the year 1907-08 had amounted to Rs. 85,520, had already begun to excite alarm in business circles, and three prominent representatives of European business interests in Madras recorded a minute of dissent from the resolutions relating to industrial development, holding that Government should confine assistance to commerce to matters of research, technical education, industrial instruction, and the dissemination of industrial information. On this point the Government accepted the resolution of the Conference. They recognised as a general principle that the exploitation of industries should be regarded not as a normal, but as an exceptional, function of Government, and on the general question of the limitations that should be set to the functions of the State in attempting to promote industrial development, they accepted the conclusions arrived at by the Conference. Accordingly, in March 1909, they made the following proposals to the Secretary of State :—

(1) that a permanent Department of Industries under the control of an officer to be styled the Director of Industries should be created;

(2) that industrial education, as opposed to technical education, should be placed under this department; and

(3) that the department should further be entrusted with the duty of encouraging trade by the introduction of new industries, that it should establish and maintain a bureau of industrial information, and that it should have the charge of the well-boring and pumping operations which were then in progress.

It was further proposed that an expert assistant should be attached to the Director of Industries, who should also have the assistance, as a temporary measure, of experts in dyeing, weaving and leather work.

Lord Morley's Despatch.

6. Lord Morley, however, in a despatch, dated 29th July 1910, differed fundamentally from the views expressed by the Conference and approved by Government as the functions of a Department of Industries. As before, he condemned a policy of attempting to create new industries by State interven-

tion, and he was sceptical as to the utility of State effort in this direction, unless it was strictly limited to industrial instruction and avoided the semblance of a commercial venture. The danger of a new State industry was either that it would be a petty and ineffective plaything, or that it would prove to be a costly and hazardous speculation. The policy that he sanctioned was that State funds might be expended upon familarising the people with such improvements in the methods of production as modern science and the practice of European countries could suggest. Further than this the State should not go, and it should be left to private enterprise to demonstrate that these improvements could be adopted with commercial advantage. He negatived the proposal to establish a Department of Industries, but he sanctioned the appointment of a Superintendent of Industrial Education working under the Director of Public Instruction, and he also agreed to the recruitment of dyeing, weaving, and leather experts on the condition that they should be employed for instructional purposes only. He stated further that his objections did not extend to the establishment of a bureau of industrial information or to the dissemination from such a centre of intelligence and advice regarding new industries, processes and appliances, provided that nothing was done to interfere with private enterprise.

Abolition of Department.

7. As the result of these orders the Department of Industries, which on the recommendation of the Conference had been created in anticipation of sanction in October 1908, was abolished, and Mr. Chatterton was placed under the control of the Education Department as Superintendent of Industrial Education. In that capacity he still retained control of pumping and boring operations, but the chrome tannery was sold, the hand-loom weaving factory at Salem disbanded, and all industrial institutions were transferred to the management of the Education Department. Steps were also taken to recruit the experts whose appointments had been sanctioned by the Secretary of State. The above arrangements, however, proved unworkable, and it was soon found necessary to relieve Mr Chatterton of his duties in connection with industrial education and to place him on special duty in connection with the pumping and boring operations. In July 1912, his services were lent to the Mysore Darbar, and since that date up to the present time he has not been employed in the Madras Presidency.

Its reconstitution.

8. Lord Morley's orders, however, aroused considerable opposition in India. The Sixth Indian Industrial Congress, which was held at Allahabad in December 1910, protested against the abolition of the Department of Industries and, in the following February, a resolution was passed in the Legislative Council of Madras inviting the Secretary of State to reconsider his decision. In pursuance of this resolution, the Government again addressed the Secretary of State in May 1911. They referred to the general disappointment which Lord Morley's orders had occasioned, and laid stress on the difference between the industrial conditions of India and those prevailing in Europe, pointing out how difficult it was in a country like Southern India, "to bridge the gulf which exists between mere scholastic instruction and the practical application of industrial teaching, unless factories under State management are founded." And they asked for authority, in special cases and subject to the safeguards suggested by the Industrial Conference, to undertake the experimental introduction of new industrial processes. Apart, however, from the question of State intervention on a commercial scale in industrial enterprises, they asked for a reconsideration of the decision regarding the creation of a separate Department of Industries independent of the Director of Public Instruction. They had no objection to the retention of the inspection of technical and industrial schools under the Director of Public Instruction, provided that a separate Inspector

was appointed, but they pointed out that such matters as the conduct of a bureau of industrial information and the supply of expert advice regarding the purchase of industrial and agricultural machinery were outside the province of the Educational Department. These proposals were supported by the Government of India, and Lord Crewe's reply was not altogether unfavourable. He reaffirmed Lord Morley's decision against the extension of the activities of a Department of Industries to trading on a commercial scale, but he had no objection to the creation of a separate Department of Industries, provided that its functions were confined within the limits which will be referred to later. He asked for further information regarding the proposed appointment of an Inspector of Industrial Schools, and it was not until the end of 1913 that final orders were passed on this point, the control and supervision of industrial, as opposed to technical, schools being transferred to the Director of Industries, for whose assistance an appointment of Inspector of Industrial Schools was sanctioned. Accordingly the Department of Industries in its present form came finally into existence on the 21st March 1914. The functions of the Director were thus defined:—

(1) to collect information as to existing industries, their needs and the possibility of improving them or of introducing new industries;
(2) to carry out and direct experiments connected with local enquiries;
(3) to keep in touch with local manufacturers, to bring the results of his experiments to their notice, and to obtain their co-operation in the conduct of experiments on a commercial scale;
(4) to supervise the training of students; and
(5) to advise Government with regard to technical matters involving legislation.

Subsequent changes

9. Since these orders were passed, the only important change in the function of the department has been the transfer in 1916 to the Agricultural Department of all pumping and boring work. But the outbreak of the war in August 1914 seriously prejudiced the work of the department in some of its branches. Experimental and teaching work by the Dyeing Expert has been stopped owing to the lack of dye-stuffs. The Leather Expert joined the Indian Army Reserve of Officers in July 1915. The officiating Director (Mr. Tressler) followed suit last August, and a Civilian has been placed on special duty to submit proposals for the reorganisation of the department.

Present staff.

10. The superior staff of the department now consists of an officer on special duty, a Dyeing Expert, and a temporary engineer who acts as Assistant Director. The Leather Expert is at present on military duty, and his place has been filled temporarily by an assistant who, as a Government of India scholar, was trained in tanning at home. There is a sanctioned post of Weaving Expert which is at present vacant. Sub-Engineers of the Public Works Department are at present in charge of the Madura Technical Institute and of the Glass Factory, and there are three sanctioned posts of supervisors. The question of organising a district staff is now before Government. An Inspector of Industrial Schools has just been appointed.

11. Brief notes are appended on some of the activities of the department since its inception.

Aluminium.

12. The first reference to aluminium in Madras that appears in the records was in 1891, when Mr. Chatterton made proposals to the Government for the utilisation of water power in the manufacture of the metal. A committee of experts was appointed by the Secretary of State to examine the proposals, and in due course a report was published, and the matter left to private enterprise. Nothing practical resulted therefrom till Mr. Chatterton went on furlough in

1896. He then consulted the officers of the British Aluminium Company, who informed him that there was no prospect of commercial success attending the manufacture of aluminium in India, unless there was a large local market for the metal. He then, with the sanction of the Director of Public Instruction, proposed to introduce the working up of aluminium into some of the industrial schools in the Presidency and, on his return from furlough at the end of 1897, he brought out a hundredweight of metal for the purpose. He was given permission to make experiments in the School of Arts and, early in 1898, he applied for funds to carry on the work. This application was refused; but a further application to carry on the work at his own expense was sanctioned. At the end of March, Government reversed their previous decision and sanctioned the expenditure of a sum of Rs. 3,800 on the purchase of metal and agreed to the experiments forming an integral part of the work of the School of Arts. No great difficulty was experienced in manipulating the metal, and, from the outset, the work done was sold, though it was naturally rough and deficient in finish. Coppersmiths and bell-metal founders were employed, and, at first, indigenous methods of working were adopted. But gradually, as the workmen became more skilled, changes were made, and improved methods and modern tools were introduced, with the result that the cost of production was considerably reduced. Attention was also paid to the commercial side of the venture. From the outset there was a good demand from the military authorities and from Europeans for aluminium vessels, and by establishing agents and subsidiary workshops at various places, the Indian demand was also stimulated. The following figures give the annual receipts and charges of the aluminium department till it was sold in 1903:—

Year.	Receipts.			Charges.		
	Rs.	A.	P.	Rs.	A.	P.
1897-98	...			3,800	0	0
1898-99	44,621	13	9	45,014	7	5
1899-1900	91,432	0	8	93,000	0	0
1900-01	1,37,452	2	9	1,94,936	14	0
1901-02	1,84,549	13	8	2,34,874	7	7
1902-03	1,69,711	15	8	2,24,001	0	8
1903-04	2,91,582	8	6	94,142	15	1

13. In 1900 the Indian Aluminium Company was formed by Mr. Eardley Norton, then practising as a barrister in Madras, with the view of following up and developing the pioneer work of the Department of Industries. For the time the company worked in conjunction with the department to open up a market in India, and in 1903 it was decided that the time had arrived when private enterprise could be left to carry on the business unaided. Accordingly in September 1903, the company took over the aluminium department of the School of Arts, purchasing all the tools, plant and stock after valuation. The results of the valuation showed that the department had made a nett profit of about Rs. 60,000 during the period it had been pioneering the industry. Of this surplus one half was surrendered to the Indian Aluminium Company as a free gift to enable it to finance the transfer. The Government of India also permitted Mr. Chatterton to act as Consulting Engineer to the company for a period of eighteen months from the date of transfer. The company is now firmly established in Madras. It has extended the use of machine processes as far as possible in its workshops, but in spite of this fact it employs on an average nearly 250 workmen. The nominal capital of the company is Rs. 10 lakhs. In the six years preceding 1914 it paid on an average a dividend of 12⅔ per cent. on a paid-up capital of Rs. 6,80,000, but since the war owing to army

contracts its dividends have been much larger. Since the prohibition of the import of aluminium into India—a war necessity—the company has taken up the manufacture of copper and brass ware. From plans prepared by Mr. Chatterton, it has furnished the equipment of the two large sandalwood-oil distilleries which have recently been started in Bangalore and Mysore. The manufacture of aluminium vessels is also carried on in seven factories in the city of Bombay and in three factories in Ratnagiri. It has also become a bazaar industry in the Godavari district of this Presidency. Before the war 60 or 70 workshops were engaged in the industry in Rajahmundry alone, and 3,000 men were employed, the men skilled among them earning from Rs. 30 to Rs. 40 a month. The vessels manufactured were sent all over India as far as Benares in the north and Madura in the south. But, as the figures given below indicate, the bazaar industry has been hard-hit by the war. The export of aluminium from England has been prohibited, and it is now unprocurable except at fancy prices.

14. Aluminium is not made in India, and the existing industry, which is entirely an offspring of the company's work at the School of Arts, extends only to the manufacture of aluminium vessels. But such as it is, and though the war has materially affected it, it is an industry of some dimensions as the appended table of imports of aluminium into India shows:—

Table of imports.

Year.	Bombay.		Madras.		Cocanada.		Total.	
	CWT.	LAKHS. Rs.	CWT.	LAKHS. Rs.	CWT.	LAKHS. Rs.	CWT.	LAKHS. Rs.
1904-05 . . .	...	...	890	1·05	...	...	890	1·05
1905-06 . . .	188	0·25	1,615	1·81	...	..	1,803	2·06
1906-07 . . .	429	0·71	1,535	2·18	...	...	1,964	2·89
1907-08 . . .	1,126	1·73	1,570	1·89	...	...	2,696	3·62
1908-09 . . .	1,158	1·03	2,275	1·91	301	0·27	3,734	3·21
1909-10 . . .	5,373	4·04	4,477	3·46	1,898	1·52	11,740	9·02
1910-11 . . .	7,875	6·38	2,336	1·78	1,573	1·08	11,784	9·24
1911-12 .	12,258	8·91	6,267	4·39	3,086	1·90	21,611	15·20
1912-13 . . .	26,118	19·46	4,089	2·82	4,847	2·90	35,054	25·18
1913-14 . . .	17,714	14·90	5,056	3·81	3,362	2·48	26,132	21·19
1914-15 . . .	7,673	6·46	3,681	3·10	3,242	2·32	14,596	11·88
1915-16 . . .	10,407	9·75	3,141	2·90	1,301	0·95	14,849	13·60

Chrome tanning.

15. The question of the intervention by Government in the Madras tanning industry was first taken up in January 1903, when the Chamber of Commerce was consulted as to the causes which had led to the temporary decline of the industry in Madras, and as to whether Government could do anything to assist the industry. The Chamber's reply was in the negative. It ascribed the falling off in the industry to a natural reaction following the over-production of the previous years, and thought that the industry would revive in the natural course without interference by Government. Chrome tanning was not feasible in Madras owing to climatic difficulties, the process having already been tried by an experienced tanner brought out from

home and found impracticable. The whole question was reviewed by Mr. Chatterton in a report, which was later expanded into a monograph on the Madras Leather Trade, and in March 1903 Government decided that no reason existed for State intervention. Later on, however, in the same year this decision was reconsidered with reference to the economic waste involved in the use of country leather for *kavalais* or the buckets used by the ryots for well irrigation. Large numbers of these buckets were required annually by the ryots, for owing to inferior methods of tanning the leather perished after a comparatively short period of use, and Mr. Chatterton suggested that experiments should be made with the object of introducing and popularising the more enduring chrome leather. In September 1903, therefore, Government sanctioned the expenditure of a sum of Rs. 2,000 on experiments in the School of Arts to determine whether chrome tanning could be successfully carried on in the Presidency, the object in view being not to manufacture a leather which would compete with the products of Europe and America, but merely to turn out something superior to the locally made article. The field of chrome tanning was at that time clear. It is true that in 1910, when the operations of the department had led to the whole question of State interference with private enterprise arising in an acute form, the Chamber of Commerce explained that its letter of 1903 had been written solely with reference to chrome tanning by the two-bath process, and stated that the one-bath process had been found practicable before the department had undertaken its further development. Nevertheless, it does not appear that at the time when the department began work, any one else was engaged in chrome tanning, though Mr. Chambers, of Messrs. Chambers & Co., began work on an experimental scale some months later, instigated by Mr. Brand, the Assistant in the School of Arts in immediate charge of the experimental work.

16. The experiments at first were conducted on a small scale, the establishment consisting merely of a tanning *maistry*, a flesher and three coolies, but, even in the first year, the sales amounted to Rs. 4,779, and enquiries from all parts of India indicated that the venture had aroused considerable interest. The demand for water buckets, however, was not great at first, and it was soon found necessary to embark on the manufacture of boots, shoes and sandals, partly in order to popularise the use of chrome leather and partly in consequence of the difficulty of disposing of the leather cuttings not utilisable in the making of water buckets. Chrome-leather water buckets gradually became more popular, and, in the year 1908-09 Rs. 9,000 worth of leather was sold for this one purpose in two districts of the Presidency, but the main business of the department always consisted in supplying the demand for foot-wear, especially sandals. A boot shop was opened in the Mount Road by private enterprise, and large orders for sandals were obtained from some Government departments. In 1907-08 alone, nearly 20,000 pairs of sandals were sold. The scale of these operations necessitated the removal of the department from the School of Arts, and, in March 1908, the department moved over to a tannery of its own at Sembiam near Madras. Another consequence was that the commercial side of the venture now began to attract attention. At the end of 1908, Messrs. Chambers & Co. entered a protest against the department's interference with private trade, and, in the following year, further protests were made by the Upper India Chamber of Commerce and by the Madras Chamber. In reply to these protests Government expressed their willingness to withdraw from the venture, and, in July 1910, they accepted an offer from the Rewah Darbar to purchase the plant of the tannery for the sum Rs. 50,000, the whole stock also being taken over at a valuation. The transfer was finally effected in the beginning of 1911.

17. The appended statement shows the receipts and charges of the department from the inception of the operation till the tannery was finally closed down :—

Total cost of the chrome-tanning department from the beginning to the end.

Expenditure.	Details.	Total.	Receipts.	Details.	Total.	Net cost.
	Rs. A. P.	Rs. A. P.		Rs. A. P.	Rs. A. P.	Rs. A. P.
Capital outlay.			*Receipts.*			
Land and buildings	13,100 0 0					
Machinery	35,518 0 0		Sale of the tannery with machinery.	50,000 0 0	50,000 0 0	
Improvements to buildings.	20,978 0 0	69,596 0 0				
			Sales—			
Charges.			1903-04	41 0 0		
			1904-05	4,470 0 0		
			1905-06	25,629 8 9		
1903-04	2,200 0 0		1906-07	51,465 2 1		
1904-05	5,495 0 0		1907-08	85,357 3 9		
1905-06	49,435 6 4		1908-09	1,07,798 0 6		
1906-07	72,322 3 0		1909-10	83,971 4 4		
1907-08	88,727 12 7		1910-11	92,585 6 2	4,51,317 9 7	
1908-09	1,35,463 10 0					
1909-10	99,704 13 9					
1910-11	33,626 15 11	4,86,975 13 7				
		5,56,571 13 7			5,01,317 9 7	55,254 4 0

Note.—Figures are taken from the draft final report after the closing of the chrome tanning business.

It will be seen that the nett cost to Government was Rs. 55,000 odd spread over a period of seven years. The chrome-leather industry is now firmly established in India, at any rate as regards certain classes of leather, and there is no doubt but that the Government of Madras helped materially to contribute towards this result. Messrs. Chambers & Co.'s tannery at Pallavaram now employs about 1,100 men, partly on bark and partly on chrome tanning.

18. The superintendent of the Mysore Tannery, Limited, and managing agent of the Berhampur Leather Manufacturing Company, Limited, (which two tanneries turn out, it is reported, Rs. 1,50,000 worth of chrome upper leather every month) was trained by Mr. Chatterton, and in addition there are the following tanneries in India engaged to a greater or less extent in the manufacture of chrome leather :—

The National Tannery, Calcutta.
The Utkal Tannery, Cuttack.
The Thazgunj Tannery, Agra.
The Allahabad Tannery, Allahabad.
The Rewah State Tannery, Umaria.
The Calcutta Tannery Syndicate, Calcutta.

At least two of these tanneries were started by students originally trained by Mr. Chatterton.

Weaving.

19. Experiments in improved methods of weaving were commenced in the beginning of 1901-02, and a few fly-shuttle looms were set up in the School of Arts with the object of obtaining experience as to their working capacity and data regarding their possibilities. At the same time certain improved methods of sizing, chiefly hank sizing, were tried. About the beginning of next year, the looms were removed to the Anjuman Buildings and the experiments continued there. Hank sizing was soon given up, as the results of the experiments were found unsatisfactory. The looms were of the type of those already in use in the Basel Mission weaving establishments in the Madras Presidency on the west coast, but, so far as

was known, no attempt had ever been made to turn out purely indigenous cloths on fly-shuttle looms, and it was to achieve this object that investigations were begun. At first the manufacture of Madras handkerchiefs was taken up, and, though it was not much of a success at the beginning, gradual improvements were effected. Experiments with the Madras handkerchiefs and subsequently with other classes of indigenous goods, such as *saris* and *dhotis*, yielded results which left no doubt as to the practicability of turning out a much larger percentage of cloth on a fly-shuttle loom than on the ordinary country loom. In 1905 it was decided to continue the experimental work in a properly organised hand-loom weaving factory. Accordingly, in February 1906, a weaving factory was opened at Salem, where there was a large weaver population, the objects in view being, in the words of Mr. Chatterton, to ascertain by experiment whether it was possible to improve the conditions of the hand weavers in Southern India:—

(1) by substituting for the country hand-loom an improved hand-loom which would enable the weaver to produce a greater length of cloth in a given time, without in any way sacrificing the essential characteristics of the country hand-woven goods;

(2) by introducing the factory system among weavers, so that they might work under the management of men with commercial and manufacturing experience and so that capital and organisation might be introduced into the industry; and

(3) by introducing, if possible, improved preparatory processes to diminish the cost of the preliminary warping and sizing.

20. Much difficulty was experienced in getting together a sufficient number of capable hand weavers adequately to test the possibilities of a hand-loom factory. Good wages and regular continuous employment were offered, but the weavers much preferred working in their own houses assisted by their women and children, and evinced great dislike to the discipline and regular hours incidental to factory life. Few of them moreover were free agents. Most of them were in the hands of the cloth merchants, who viewed the factory with suspicion and directed their influence against it. By dint of patience, however, improvement was effected, and though, even in the last year of the factory's existence, complaints were made that practical weavers of the right class would not work in the factory, the financial results of each year showed a progressive improvement and indicated that, if properly managed, a hand-loom factory might be a success. Thus the factory aroused considerable interest, and was the direct cause of numerous small private factories being started. Subsequent investigations showed that most of these factories failed sooner or later, the causes of the failure being, it was reported, (1) lack of technical knowledge on the part of the management, (2) inability of the directors to work harmoniously together, and (3) the dislike of the weavers themselves of discipline and control; but, as will be shown later, they helped to popularise the fly-shuttle loom.

21. Not much progress was made in the improvement of the preparatory processes in order to diminish the cost of the preliminary warping and sizing. A complete plant of warping and sizing machinery was obtained from England in 1907, but only negative results were obtained, and little further work on the problem was attempted at Salem. One of the facts, however, brought out by the weaving competition held at Madras in 1908 was that the sizing methods of the Presidency were much in advance of those in use in other parts of India.

22. Undoubtedly the most useful work done at the factory was in connection with the first of the problems which Mr. Chatterton set out to solve. From the time when weaving had first been started by Government, experiments had

been made with the fly-shuttle loom and various small improvements had been effected, and the type of loom ultimately adopted at the Salem Factory was practically the old English fly-shuttle loom, modified as far as possible in the direction of simplicity and so as to suit it for the manufacture of indigenous cloths. But numerous other types of improved looms were kept under observation and trial, and, in 1908, a weaving competition was arranged at Madras with the object of procuring definite data regarding the merits of the various types of loom which were then being offered to the Indian weaver. The result of the competition was to confirm the conclusions of the Salem Factory, the looms which did the best all round work being those manufactured at Madras on the lines of the old English hand-loom. The advantages of this type of loom over the country loom have been described as follows :—

(1) The fly-shuttle slay is cheaper than the ordinary slay;

(2) the fly-shuttle gives a greater outturn; the increase varies not only with the experience and skill of the weaver, but also with the different counts of yarn used, the outturn relative to that of the country loom being nearly double in the case of coarse counts, more than 50 per cent. greater with medium counts and rather less than 25 per cent. greater with finer counts ranging from 80's to 150's.

Efforts accordingly were made to spread the use of the fly-shuttle loom, but the results were not at first apparent, and pessimistic remarks about the prospects of success appear more than once in the earlier reports. As a matter of fact, the use of the fly-shuttle spread with considerable rapidity, partly owing to demonstration work done by the private factories alluded to above, and a census of fly-shuttle looms in ordinary use, taken in 1911, revealed the existence in the 89 towns and villages visited of not less than 6,528 looms fitted with fly-shuttle slays. Practically all these villages were in the coast districts north of Madras, and it was estimated that in these districts roughly 40 per cent. of the weavers had adopted the new method of plying the shuttle.

23. The factory was worked on a commercial scale, so far as an experimental factory could be run on commercial lines. Besides cotton goods, silk cloths and worsted shawls were manufactured, and the sale receipts in some years amounted to nearly Rs. 12,000. But this fact proved the factory's undoing. The Chamber of Commerce entered a protest; Lord Morley's ultimatum followed shortly afterwards; and the factory was closed in September 1910.

24. In the meantime, on the recommendation of the Industrial Conference, it had been decided to appoint a weaving expert and to open a weaving institute at Madura. A Government of India scholar was appointed to the expert's post, but he was not much of a success, and his services were dispensed with after a few months' trial. The project of a weaving institute at Madura also took a long time to mature, and after the closure of the Salem Factory, some rather desultory work followed, mainly in the demonstration of jacquard looms. At the end of 1911, however, as already noted, a census of fly-shuttle looms was made. It was found that the loom had already become very popular and that the use of it was steadily increasing, and the enquiry also indicated that further demonstration work was necessary in the direction of introducing (1) some sort of warping mill in places where the fly-shuttle had been adopted, (2) dobbies for weaving simple designs, (3) the jacquard machine for complicated patterns, and (4) the frame loom, wherever it might be profitable. Previous experience pointed to the conclusion that the best way to convince the weavers of the efficiency of any new appliance was by demonstrating it at their very doors,

and though it was recognised that the introduction of improved appliances would not by itself solve all the problems connected with the improvement of the material condition of the weavers, it was decided to organise a peripatetic weaving party for the purpose of demonstrating to the weavers the advantages of improved methods of work and appliances.

25. The first party accordingly was organised in March 1913 for work in the southern districts of the Presidency. The party consisted of a superintendent and five weavers, and was equipped with the following plant; warping mill, beaming frame, frame loom with automatic take-up motion, spare slays, dobbies, jacquard machine, and card-cutting machines. A small stock of machinery for sale was added. A second party for the Northern Circars was organised in 1914. In the southern districts the chief work done has been in pushing the introduction of fly-shuttle slays and dobbies, but in the northern districts, where weaving is more advanced, warping mills and dobbies have been popularised to some extent.

26. The cost of the weaving operations of the department in each year since the operations were begun is exhibited in the following table:—

Weaving experiments.

Year.	Receipts.	Expenditure.
	Rs.	Rs.
1901-02	177	2,281
1902-03	4,174	12,779
1903-04	3,592	10,210
1904-05	3,427	7,037
1905-06	2,512	10,935
1906-07	6,623	17,535
1907-08	10,537	15,023
1908-09	11,775	15,768
1909-10	8,601	14,341
1910-11	9,147	11,390
1911-12	1,430	5,476
1912-13	1,054	4,229
1913-14	3,156	9,521
1914-15	2,347	8,921
1915-16	1,417	9,501
Total	69,969	1,54,947

27. The nett expenditure was thus Rs. 84,978 spread over fifteen years. In return for this expenditure the department can claim to have attained a considerable measure of success in the introduction of the fly-shuttle loom and other improved appliances. Ten years after the first experiments were begun, as the result of the census taken, 6,500 looms out of 15,500 counted were found to be fitted with fly-shuttle slays, and it was estimated that in the coast districts north of Madras 40 per cent. of the weavers had adopted the fly-shuttle. In 1915, the proportion in the Kistna district had risen to two-thirds, and, at a conservative estimate, the number of fly-shuttle looms in use in the Presidency may be put at something like 15,000. Mr. Chatterton has estimated that the adoption of the fly-shuttle increases the wages of a weaver by Rs. 2-8-0 per mensem, and, on the basis of this figure, the monthly increase in wages resulting from the adoption of the fly-shuttle may be put at Rs. 37,500 per mensem, or Rs. 4½ lakhs per annum.

Pumping and Boring.

28. The records of the pumping and boring branch of the department are very voluminous, and it is not possible here to give more than a very brief sketch of the development of the operations. In September 1903, the aluminium

industry was made over to the Indian Aluminium Company, and, as part of his programme of work in connection with the development of Indian industries, Mr. Chatterton proposed that a number of pumping installations should be set up with the object of demonstrating the advantages of modern machinery in agricultural operations. Some work had already been done in this direction, and Mr. Chatterton himself and the Public Works Department had both experimented with pumping by machinery. But these experiments had furnished evidence merely as to the value of lift irrigation on a comparatively large scale, and much scepticism still prevailed as to whether comparatively small areas of land could be profitably irrigated by small engines and pumps. One small installation had already been put up at Melrosapuram in the Chingleput district, and, in 1904, permission was obtained to open four other pumping stations, where experiments were begun with engines varying in horse power from 3½ to 6½, and with three and four-inch pumps. From the first, the progress made was encouraging, and by March 1905 so many applications for assistance had been received that Government agreed to advances being made under the Land Improvement Loans Act for the purchase of oil engines and pumps, and provided Mr. Chatterton with the nucleus of a staff to assist those wishing to put up installations with advice and supervision. A class for training oil-engine drivers was also opened at the School of Arts. It soon became evident, however, that very few of the wells in the Presidency could furnish enough water to make it worth while to put in an engine and pump, and that, in order to bring pumping installations into more extended use, it would be necessary to deepen existing wells or to sink new ones so as to tap the subterranean reservoirs, which were suspected to exist at no very great depth in certain districts of the Presidency. These results had been anticipated from the very beginning, and, in 1904, a set of boring tools was purchased, with which experimental borings were put down in various places. This led to the discovery of sub-artesian water both in the Chingleput and South Arcot districts, and it became evident that it was desirable greatly to extend the scale of operations. Accordingly, in 1906, the boring branch of the department was inaugurated by the deputation of a special party to the Chingleput district, partly to develope well irrigation by the expeditious disposal of applications for loans, and partly to prevent waste of money by preliminary borings before wells were sunk. Later on, the operations of the party were extended to the improvement of existing wells, and from this time forward progress was rapid, until the outbreak of the war operated as a check. By March 1916, operations were in progress over nearly the whole of the Presidency, and 3,333 borings had been put down. Rather more than half of these borings were made for the purpose of improving existing supplies, the remainder being fresh explorations. The percentage of success is reported to have exceeded 60, sub-soil water being met with at depths ranging from 35 to 200 feet. In the same period, 818 local investigations were made in connection with projected pumping installations, more than 400 installations were set up, and a sum of Rs. 2,99,800 was advanced under the Land Improvement Loans Act to 117 persons for the purchase of oil engines and pumps. Many other installations were put up independently of the department, the machines being mostly obtained from engineering firms on the hire-purchase system, and an admittedly incomplete census taken in 1915 disclosed the existence of nearly 900 installations irrigating an estimated area of nearly 50,000 acres. In addition, a number of oil engines were installed under the advice and with the aid of the department, in rice mills and other industrial concerns.

29. The rapid increase, however, in the popularity of oil engines and pumps entailed correspondingly heavy work in the department. In the cir-

cumstances of South India, it was necessary to provide for the supervision and periodical inspection of the pumps. A system of compounding fees was accordingly instituted, and, by 1915, 256 plants were on the inspection list. For inspection and boring purposes the pumping and boring staff was augmented from time to time, till, in 1915, it consisted of 12 supervisors, 21 mechanics and 38 boring *maistries*. Much of the Director's time was taken up in the supervision of his supervising staff and in what was practically consulting engineering work. Most of this work, moreover, was work which really appertained to the Agricultural Department, and eventually that department was strengthened by the appointment of an Agricultural Engineer who has relieved the Director of Industries of all work connected with pumping and boring.

The following statement exhibits the cost of the pumping and boring department from 1904-05 to 1915-16:—

Pumping and Boring Operations.

Year.	Receipts. Rs.	Expenditure. Rs.
1903-06	......	*65,033
1906-07	......	14,105
1907-08	53	21,444
1908-09	2,692	39,177
1909-10	4,370	46,908
1910-11	5,987	66,299
1911-12	14,461	63,060
1912-13	26,407	98,757
1913-14	31,237	1,54,076
1914-15	38,654	1,58,017
1915-16	40,429	1,17,920
Total	1,64,290	8,44,796

Industrial installations.

30. The oil engines first used by the department were worked with kerosene oil; but at the request of the Shell Transport and Trading Company, which then supplied Madras with kerosene oil, experiments were taken up with a view to utilising the very large stock of liquid fuel which had been brought out to Madras, in the hope that it would be found suitable for generating steam in the mills and factories. The scheme proved a failure and the company were left with a large tank containing about 4,000 tons of liquid fuel on their hands. It was found that the Hornsby-Ackroyd oil engine was equally well adapted for use with either liquid fuel or kerosene oil and, on this fact being made known by Mr. Chatterton in a letter to the "Madras Mail," the numerous users of Hornsby-Ackroyd oil engines in the Madras Presidency naturally at once displaced kerosene oil, which cost from 7 annas to 8 annas a gallon, by liquid fuel, which could then be obtained at 2 annas a gallon in Madras. The great reduction in the cost of generating power, consequent upon this discovery, gave a considerable impetus to the development of small power installations. These were principally applied to the preparation of agricultural produce for the market and, in the course of a few years, numerous paddy hullers, oil mills and a few saw mills and sugarcane-crushing mills were installed.

31. In 1911, Mr. Chatterton urged on the Government the necessity for experimental work in connection with the manufacture of jaggery and, a sum

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* Includes Rs. 15,081 spent when the experiments were in charge of the Public Works Department. The figures are taken from the Annual Administration Report.

of Rs. 10,000 being placed at his disposal, a jaggery-boiling plant on improved lines was set up in the village of Singanallur near Coimbatore. Very little progress had been made when he left Madras for Mysore, and, on the establishment of a Department of Industries in that State, a number of similar plants were set up by him. Arrangements were made for the two departments to work in co-operation, with the ultimate result that very considerable improvements were effected, and a large number of installations have been set up both in Mysore and the Madras Presidency. A full account of the work done in this connection will be found in Bulletin No. 55 of the Agricultural Research Institute, Pusa, which is entitled, "The Manufacture of Jaggery in South India."

Experimental work.

32. Allusion has already been made in paragraph 12 to the proposals submitted by Mr. Chatterton in 1891 for the utilisation of water power in Southern India, and, although these have not been carried out, they drew attention to the value of water power, and undoubtedly first suggested to the Mysore Government the idea of utilising the Cauvery Falls at Sivasamudram. Later on, in 1902, extensive studies were made regarding the cost of generating power in Southern India, the results of which were published in the "Indian Review" of that year. This paper was communicated to the agents of the Kolar gold mines and resulted ultimately in the central generating station, which was erected at the mines to supplement the supply of power from the hydraulic installation at Sivasamudram.

Recognising that cheap power was essential to the development of the country and that the south of India was greatly handicapped by the dearness of fuel, experiments were also started in 1902 to determine the value of wind mills as a source of power for lifting water for irrigation. Messrs. Parry & Co., the Madras agents of the Chicago Aer-Motor Company, provided a 16-foot aer-motor mounted on a 70-foot tower, and this was erected in the compound of the School of Arts, and its performances were kept under observation for more than a year. The results of the investigation were published in June 1903 in a bulletin issued by the department, entitled, "The Value of Wind Mills in India."

In 1906, a similar report was published on experiments in pumping with oil engines and centrifugal pumps. Attention was drawn to the defects of the existing pumps on the market, and, falling into the hands of an engineer in England, it resulted in this gentleman setting himself the task of producing a new pump free from these defects. This led to the invention of the Rees Roturbo pump, which is now extensively used all over the world and has been adopted as the most suitable type of pump for the majority of the installations in this Presidency.

In 1906-07, the flow of water in spring channels in the South Indian rivers was investigated, and it was found that when the hydraulic gradient was less than one in about 250, the water is unable to move through the sand. This disposed of the idea that there was a subterranean flow of water in the beds of our rivers and explained the partial failure of water-supply schemes for towns like Madura, Trichinopoly and Conjeeveram. A full account of the investigations is given in the report of the experimental pumping department for the year 1906-07.

The development of irrigation by pumping with oil engines and centrifugal pumps gave rise to a considerable number of investigations regarding the duty of water in the South of India and the results have been published from time to time in the bulletins and annual reports which have been issued.

Enquires.

33. It would unduly extend the scope of this memorandum to furnish any detailed account of the industrial enquiries which have been made but have

yielded no practical results. Only two matters are of sufficient importance to be referred to.

Utilisation of the Periyar water power.

34. Reference has already been made in paragraph 12 to Mr. Chatterton's original proposals. A revised scheme was submitted by him to Government in 1908, the principal feature of which was the regulation of the Periyar lake so as to provide a perennial supply of water sufficient to yield 20,000 h. p. for 12 hours every day throughout the year. It was proposed to transmit this power to Madura, and the owners of the mills there signified their willingness to use it. The scheme fell through when referred to the Government of India, owing to objections raised by the Inspector-General of Irrigation. The importance of industrial development was not then so keenly appreciated as it is now, and it is possible that in the future the Irrigation Department may be prepared to waive their objections.

Wood distillation.

35. In January 1907, Mr. Chatterton invited the attention of the Board of Revenue to the question of the manufacture of charcoal from timber grown in the neighbourhood of the Buckingham Canal. He proposed the establishment of a wood-distillation plant to manufacture charcoal, for which a market was anticipated in Madras and elsewhere as fuel for suction gas producer plants as well as for the ordinary requirements of the city. Of the by-products, the most important was acetate of lime which was needed by the Cordite Factory at Wellington for conversion into acetone. Government sanctioned the preliminary proposal to send a sample consignment of ten tons of casuarina wood to England, to ascertain what percentage of charcoal it would yield and what would be the value of the by-products. The tests were eminently satisfactory, and a very extensive correspondence developed, which was ultimately referred to the Industrial Conference which was held at Ootacamund in September 1908. Finally, the proposals were submitted to a committee, chiefly consisting of non-official gentlemen, who were asked to state whether the industry was to be left to private enterprise or to be taken up by Government. "The Committee were of opinion that Government could not undertake the establishment of a factory for wood distillation on a large scale without undue interference with private enterprise, though, upon the information at present available and in view of the uncertainty of a market for some of the most important by-products, it was highly improbable that private enterprise would embark upon an undertaking of so much importance and difficulty." The Government accepted the opinion of the committee and decided to take no further action in the matter. Had wood distillation then been started as was proposed, there is not the least doubt that it would, by now, have been an industry of great national importance in India as some of the by-products are of great military value.

Pencil factory.

36. In 1908, two pencil factories were started in the Vizagapatam district, one at Bimlipatam and the other at Anakapalle. The Bimlipatam Company imported machinery from Germany, but, after spending about Rs. 28,000, failed to make pencils and sold the plant to a group of merchants at Cocanada. The factory was then started at Cocanada under the management of an Indian who claimed to have studied the processes of pencil manufacture in Japan. But, after spending some Rs. 14,000, he failed to make saleable pencils, and operations came to a standstill. The Anakapalle Company began life with a paid-up capital of Rs. 5,000 and a loan of Rs. 6,000. But this capital was exhausted in procuring machinery from Germany, and further sums were borrowed in order to enable the company to work. No expert appears to have been employed, and all attempts to make pencils failed. The machinery was made over to the creditor in payment of the money owing to him, and

eventually passed into the possession of the superintendent of an industrial school at Waltair.

37. In 1914, the attention of the Department of Industries was drawn to the industry which was then defunct, and terms were arranged on which the department obtained the use of the machinery. An expert was obtained and some pencils were made. But it soon appeared that the expert was expert only as regards the wood part of the process, and that he was unable to assist in the production of a satisfactory lead. His services were accordingly dispensed with in March 1915, and a Supervisor of the department was sent to Bangalore to study the composition of the lead in imported pencils with the help of the chemists of the Tata Institute. The refinement of the crude graphite also gave some trouble, but eventually, with the help of Professor Erlam Smith of the Presidency College, an effective method was discovered. Many other samples of Madras graphite were also tested, but none of the deposits in the Presidency are regularly worked, and since the graphite usually occurs in pockets, it is doubtful whether it will ever pay to work them. Eventually, therefore, it was decided to make use of Ceylon graphite, which can be bought on the basis of a guaranteed carbon content. The question of wood gave far more trouble. Nearly 80 Indian woods have been tested, but so far no really satisfactory Indian wood has been discovered, and the efforts made to place on the market a cheap white wood pencil made of Indian timbers have not been successful. The experiments with Indian woods are still going on, but the experience gained points clearly to the conclusion that pencil factories in India, as in European countries, will have to rely mainly on imported cedar. Fortunately there is a source of supply comparatively close at hand in British East Africa. Besides black lead pencils of different kinds (including carpenters' pencils and diary pencils), satisfactory copying pencils have been made, though the outturn of this class of pencil is limited by the scarcity of methyl violet of the right quality. Experiments have also been made with coloured pencils. The factory is now being run on commercial lines, and it is hoped that before long it will be possible to make it over to private enterprise.

Glass manufacture.

38. The original experiments in glass making in this Presidency were carried out at Ennore near Madras by the late Mr. James Short and Mr. August Scholl, of Messrs. Volkart Brothers. Satisfied with the results of their preliminary enquiries regarding the supply of the requisite raw materials and with the success obtained by the experiments, they floated a company in 1909 with a capital of Rs. 2,00,000. A German expert and four Austrian blowers were brought out. An intermittent furnace and gas producer were constructed and work was started in 1910. In March 1910, a free grant of half the wood used in the company's furnace for the first two years of its working, up to a maximum of 7,200 tons for the whole period, was granted by Government. Mouth-blown soda-water bottles were produced which stood a pressure of 260 lb. per square inch, and were used in large quantities by Messrs. Spencer & Co., and found perfectly satisfactory.

39. After working for some time it was found that the available local labour could not turn out mouth-blown bottles in sufficiently large quantities to make the business profitable, and it was decided to get automatic machines. In 1911, therefore, six bottle-making machines, an air compressor and mechanical gear were obtained from Messrs. Forsters of St. Helens. The factory worked till November 1911 and turned out a considerable number of soda-water bottles, the maximum output in any one month being upwards of 26,000. The company, however, experienced many difficulties. The furnace had been

constructed on a faulty design. It was an intermittent one, and work had to be stopped every time the furnace was charged. The concession of Government in regard to wood fuel did not prove of much value, and ultimately coal was used at a heavy cost, and the losses in the annealing chamber were excessive. In the month referred to above, for instance, though 44,000 bottles were put into the chamber, only 26,000 sound bottles were taken out. In 1913 therefore an attempt was made to raise further capital in order to construct a new continuous furnace. But the shareholders declined to invest any further money in the enterprise, and the company went into liquidation. Nearly Rs. 3,00,000 had been dropped in the venture.

40. The property then passed into the hands of a private gentleman, and in October 1914, the factory and plant were placed at the disposal of Mr. Tressler, then Director of Industries, for experimental purposes. Efforts, however, to obtain a glass expert were not successful, and the experiments were closed down in January 1917. They led to one valuable result, namely, the appointment of a committee which surveyed the prospects of a glass-making industry in the Madras Presidency. Conditions clearly are not favourable in a locality where fuel is particularly dear, and the committee were not in favour of the experiments being continued.

Lime-sand bricks.

41. Another experiment which must be written down as a failure is that of lime-sand bricks. Proposals for the inception of these experiments were submitted in May 1914. At that time the Chetput brick fields were approaching exhaustion, and it had been decided to open a new brick field further afield. Mr. Tressler suggested that, before Government committed themselves to the expenditure involved in this scheme, the question of making lime-sand bricks should be considered. The materials, lime and sand, were available in large quantities in Madras; if properly made, these bricks had a crushing strength of between 200 to 300 tons to the square foot; and Mr. Tressler anticipated that they could be made at about the same cost as the clay brick. The experiments were accordingly sanctioned in G.O. No. 1472, Educational, dated 23rd June 1914, and an indent for machinery sufficient for an output of 8,000 bricks a day was sent home to an English firm. Part of the machinery, delivered in June 1915, was set up in accommodation kindly provided by the South Indian Industrials, but, owing to the war and the fact that one consignment was sunk by a submarine, the delivery was not completed till September 1916. Unfortunately provision had not been made for an adequate power plant. An engine of an antiquated type was lent by a local firm, and two worn-out boilers were borrowed from Government House, but with this plant it was not possible to work the grinding mill and press simultaneously. Accordingly, in September 1916, an estimate was submitted for working the plant in 1917-18 with a 50 b.h.p. electric motor. In the meantime, after all efforts to procure an engine of the horse power required had failed, a supplementary steam engine was obtained from the glass factory, and work was begun towards the end of October. A number of bricks were made. They were massive, firm, and clean in shape, and to all outward appearances were excellent bricks, but, possibly owing to the fact that sufficient pressure could not be maintained in the hardening chamber, they were not satisfactory in point of crushing strength. Not only did they vary excessively from brick to brick, but on the average they were inferior in crushing strength to the best quality Madras stock bricks. Further, though, owing to the fact that two engines and two boilers were employed for purposes of power, accurate figures of the cost of production had not been obtained, sufficient information had been gathered to make it practically certain that the bricks could not be made in Madras for the price of the best clay bricks, *viz.*, Rs. 16—18 per 1,000. An officer was then deputed to Colombo

to study the conditions in which the manufacture of lime-sand bricks was successfully carried on in Ceylon and the processes of manufacture, and his enquiries showed that, given a satisfactory power plant and provided that our processes were somewhat elaborated, we could possibly turn out a really high-class brick at a price which at a minimum, in his opinion, would not be less than Rs. 21 per 1,000. Enquiries were therefore made of the Port Trust, the Madras and Southern Mahratta Railway, the South Indian Railway, and the Madras Corporation as to whether there was likely to be any demand in Madras for a superior but more expensive brick than the best quality Madras clay brick. The answers were all in the negative. All Superintending Engineers in the Presidency were also consulted whether, owing to the absence of clay and building stone, the conditions were favourable for lime-sand bricks in any part of the Presidency but here again answers were unfavourable. Accordingly it was decided that the experiments, which had been temporarily closed down in December 1916, should be abandoned.

Technical and Industrial Education.

42. The history of the development of technical education in Madras is described in full detail in a note presented by the Hon'ble Mr. (now Sir A. G.) Cardew to the Industrial Conference of 1908. The Conference divided the subject into two parts, industrial instruction and technical education, the object of the former being "instruction in the performance of definite operations, such instruction not necessarily involving the teaching of general principles but only their application," while the object of the latter is to train a student to apply theoretical principles to practical purposes, and it then proceeded to pass a number of resolutions on the subject. Among other things it recommended that the control both of industrial instruction and technical education should rest with the Department of Industries and that a whole-time Inspector of Industrial Schools should be appointed. Government accepted this recommendation in respect of industrial instruction, but decided that technical education should remain under the Director of Public Instruction. The School of Arts and the Reformatory School at Chingleput, as well as all purely commercial schools, were also retained under the Director of Public Instruction, and eventually, in 1909, 35 industrial schools were transferred to the Department of Industries. Most of these schools were carefully inspected by the acting Director of Industries (Mr. C. W. E. Cotton), and on his report the Government proposed in 1910 the appointment of a full-time Inspector of Schools. But very shortly afterwards the Department of Industries was abolished under the orders of the Secretary of State, and the control of industrial schools was resumed by the Director of Public Instruction, Mr. Chatterton being appointed Superintendent of Industrial Education under that officer. As already noted, however, in May 1911 Mr. Chatterton was placed on special duty in connection with the pumping and boring department, and Mr. Tressler succeeded him as Superintendent of Industrial Education.

Madras Trades School.

43. In the meantime, however, Mr. Chatterton had submitted a scheme to Government for the industrial education of workmen such as smiths, moulders, pattern-makers, turners, fitters and general machine men. The main feature of the scheme was a system of State apprenticeships by which each boy would be apprenticed to a particular trade for a period of years, and it was also proposed to establish a school in an industrial centre like Perambur, where the apprentices would receive such elementary technical instruction as their educational attainments would permit them to assimilate. The scheme was referred to a committee which was composed largely of gentlemen connected with the various engineering firms and workshops in Madras, and this committee passed a number of resolutions, the most important being that a

system of State apprenticeships should be established among the engineering shops north of Madras, and that some provision should be made for technical training in a school outside the workshops. The Government accepted generally the recommendations made, and called, in August 1912, for definite proposals for the establishment of State apprenticeships and the opening of a technical school on the lines advised by the committee. Tentative proposals were submitted shortly afterwards, but the consideration of them was delayed pending the receipt of the orders of the Secretary of State on the constitution of the Department of Industries, and the question also arose whether in addition to mechanical engineering, the facilities for technical education in the proposed school should not be extended to other branches of work such as motor engineering. Another committee was appointed to consider this question in 1914 and also to work out detailed proposals both for the school and for the system of apprenticeships. This committee, which was composed largely of men of practical experience, considered that such technological education as was necessary in the Presidency might, for the present, be conveniently arranged for by means of scholarships to the Victoria Jubilee Technical Institute at Bombay, and three scholarships of the value of Rs. 30 per mensem each for four years are now awarded to natives of the Madras Presidency for the study at the above institute either of mechanical engineering, electrical engineering, textile manufactures or technical chemistry, as well as three scholarships of the same value for the study of mechanical and electrical engineering at the Madras College of Engineering. The committee also proposed that extension classes should be provided in the proposed Trades School for subjects such as fitting and turning, blacksmith's work, foundry work, carpentry and joinery, plumbing and sanitary work, brickwork and masonry, electric wiring and fitting, motor-car work and motor-car driving, weaving and dyeing, metal work and metal spinning. Government decided to begin work experimentally in a rented building, and much difficulty was experienced in obtaining a building in a suitable locality. Eventually, however, a building was secured in Georgetown and a beginning made with classes in mechanical engineering and plumbing. The school has now overflowed into another building, and classes are now held in mechanical engineering (first and second year), plumbing (first and second year), electric wiring (two classes), and machine drawing, while a class has also been opened for apprentices from the Perambur railway workshops. So far the experiment has been successful, and it is hoped to make the school permanent.

Madura Technical Institute.

44. Among the industrial schools transferred to the control of the Department of Industries in 1909 in pursuance of the recommendation of the Industrial Conference were the two technical institutes maintained by the District Boards of Madura and Tinnevelly. Subsequently, both institutes were taken over by Government, and, while the Tinnevelly institute was abolished, it was decided to rebuild and remodel the Madura one on a more ambitious scale. The institute will comprise weaving, dyeing, and mechanical departments, the central idea being that the technical and industrial education provided should be connected with the industries of the town. In the mechanical department a small workshop will be established, well equipped with different kinds of machinery, and ten apprentices will be admitted yearly for a three years' course which may be extended to five in the case of promising lads. The workshop will undertake repairs for private oil engines and pumps as well as for the pumping and boring department, and will also undertake demonstration of up-to-date agricultural and industrial machinery. The apprentices will thus be provided with practical experience, and three afternoons a week will be devoted to lectures on materials and simple forms of mechanism and to mechanical drawing. The

idea is not to turn out engineer subordinates or draftsmen, but an intelligent class of mechanics somewhat resembling the old English millwrights. Industrial classes will also be opened for carpentry and blacksmith's work. Five students a year will be admitted to each class, admission being confined to caste workmen, and the period of instruction will cover a period of five years. In the weaving department, for the present, industrial classes only will be opened. Twenty boys will be admitted each year, they will be apprenticed for five years, and will be housed in a hostel. Details of the course of instruction have not yet been worked out, but roughly three hours a day will be devoted to general education and five hours a day to practical work. The practical work will be done in a weaving factory, the object being to train workmen capable of dealing with every stage of the processes of hand weaving for every kind of cloth manufactured in Southern India. It was also proposed to tackle in earnest at the institute the question of the improvement of indigenous methods of sizing, and with this object in view to obtain "drum-winding, beam-warping and dresser-sizing" machinery from England, as well as to import an expert European sizer. But it was decided that the restrictions placed by Lord Morley upon departmental work made it impossible to test the value of this machinery on commercial lines, and this part of the scheme (which included the higher technical training of students) has been held in abeyance for the present. In the dyeing class no industrial training will be undertaken, and it has been decided that "all that is required is higher education for prospective "works owners and managers, to place them in a position to understand the nature "of the processes carried on in the works and to keep in touch with and "appreciate the value of developments in methods and dyestuffs." Instruction, for the present, will be limited to the sons of dyers and of those engaged in business connected with dyeing, and the course which, as at present arranged, will last for one year, will include instruction in elementary science and chemistry of dyeing materials, technology of textile fibres and dyeing processes.

45. Various causes have conspired to delay the opening of the institute. The negotiations with the District Board of Madura as to the terms on which the old institute should be taken over were not concluded till 31st March 1910, and a new site for the institute was not finally selected till the end of 1911. The site originally selected for the quarters of the Principal and lecturers was subsequently commandeered for the headquarters of the Ramnad district, and the acquisition of the new site has only just been sanctioned. The preparation of plans and estimates was also delayed in the Public Works Department, but final estimates for the institute and hostel, amounting to Rs. 3,24,700, have now been sanctioned, and work is proceeding steadily. In the meantime the work of the old Technical School has been carried on in temporary buildings.

Industrial schools.

46. Apart from the Madura Technical Institute, there are 35 aided industrial schools under the control of the Director. They may be roughly classified as below:—

Schools where carpentry is the principal subject taught . .	15
Schools where lace making and needle-work are the principal subjects taught	15
Printing schools	2
Agricultural school	1
Weaving schools	2
Total .	35

These schools at present follow the curriculum prescribed for the Government technical examinations, and prepare students for the examinations in the elementry, intermediate and advanced grades. The majority of these are managed by different missions, and aided by grants awarded under the Grant-in-Aid Code. One hundred and ninety-nine scholarships are at the disposal of the Director and are awarded to deserving pupils. The whole question of the policy to be followed in regard to these schools has been reviewed by Mr. Tressler, and his ideas have been embodied in a draft Grant-in-Aid Code which is now under the consideration of Government.

47. The following statement exhibits the grants paid to the industrial schools in the last four years :—

Year.	Teaching grant.	Building grant.	Furniture and special grant.	Scholarships.
	Rs.	Rs.	Rs.	Rs.
1912-13 . .	28,780	549	15,952	6,138
1913-14 . . .	29,760	24,819	17,315	6,150
1914-15 . . .	29,610	7,140	8,033	5,243
1915-16 . . .	33,273	9,639	6,104	5,259

Leather Trades School.

48. Resolution No. 50 of the Industrial Conference ran as follows :—

> "The Conference considers that the leather trade in the Madras Presidency is of "sufficient importance to justify the establishment of a Leather Trades School, which should "be associated with a small tannery in which efficient practical instruction can be given, "that provision should be made for technical education in tanning, and that in the Leather "Trades School experiments may be fitly undertaken to determine whether or not the status "of the Madras tanning trade can be improved."

Government accepted the resolution, and the Secretary of State sanctioned the school on condition that it should be a technical school pure and simple. In it workmen should be instructed in methods of chrome tanning and other processes of leather manufacture, the idea being that, if the school were properly managed, it would supply "a private capitalist with instructed workmen and with all the information he requires for a commercial venture." But no attempt was to be made to convert the school into a factory in order to demonstrate that articles can be manufactured and sold at a profit. On this understanding Lord Morley sanctioned the establishment of the school and the recruitment of a European expert in tanning for industrial purposes. Mr. Allan Guthrie of Messrs. Cooper, Allen & Co., Cawnpore, was appointed Leather Expert, and joined his appointment on 1st September 1911. In the following year, he submitted his proposals in regard to the establishment of a school. He reported that, except in the type of tools used and the methods of using them and the treatment of water, there was very little that could be taught to the expert tanners, and that it would be better to aim at the improvement of leather tanned and dressed for use in this country. He proposed, therefore, that a school should be established and worked as a small tannery, lectures being cut down to a minimum, and the greater part of the two years' course being devoted to practical work in tanning, currying and dressing, and to chemical checks in the laboratory on the practical work done. Admission should be confined as far as possible to sons of tanners and of those connected with the leather trade, and, at the outset, it was suggested that the school should be devoted mainly to the training of operatives. These proposals were approved, and a model tannery has been constructed in Washermanpet. Space has also been reserved on the same site for a Government Trades School in which lectures will be given. Unfortunately, just as the school was opened, Mr. Guthrie went off on military service, and temporary arrangements have been made to carry on the school in the tannery under the charge of an Assistant Leather Expert. Twelve students are now attending the school, which is run partly as a model tannery and school and partly as a research institute. Experiments are being conducted with wattle as a tanning agent and with various mixtures.

49. The following statement exhibits the receipts from and expenditure on the department since Mr. Chatterton first began work on aluminium in the School of Arts :—

Year	Receipts.	Expenditure.	Nett cost.
	Rs.	Rs.	Rs.
1897-98	...	3,800	3,800
1898-99	44,622	45,014	392
1899-1900	91,432	93,000	1,568
1900-01	1,37,452	1,94,937	57,485
1901-02	1,84,727	2,37,155	52,428
1902-03	1,73,886	2,36,780	62,894
1903-04	2,95,216	1,30,199	*—1,65,017
1904-05	7,897	26,930	19,033
1905-06	28,142	1,11,660	83,518
1906-07	58,088	1,27,934	69,846
1907-08	95,948	1,97,511	1,01,563
1908-09	1,22,265	2,35,800	1,13,535
1909-10	96,942	2,09,813	1,12,871
1910-11	1,07,526	1,33,195	25,669
1911-12	81,923	1,54,526	72,603
1912-13	35,890	2,21,002	1,85,112
1913-14	43,536	3,20,221	2,76,685
1914-15	50,142	4,20,246	3,70,104
1915-16	57,762	3,52,814	2,95,052
Total	17,13,396	34,52,537	17,39,141

*Nett profits.

APPENDIX K.

NOTE ON THE EXPANSION OF THE ENTOMOLOGICAL AND PATHOLOGICAL ENTOMOLOGICAL WORK AT PUSA AND IN THE PROVINCES.

By Mr. T. Bainbrigge Fletcher, Imperial Entomologist.

(To be read with the evidence of Mr. C. M. Hutchinson, B.A., M.A.E.B., Imperial Agricultural Bacteriologist, Pusa, at pages 401—416 of the Minutes of Evidence, Volume I.)

Historical.

The study of Indian entomology may be said to date from 1758, the year in which was published the tenth edition of Linnes " Systema Naturæ " which is accepted as the starting point of modern zoology. A few Indian insects were described in this publication, but in the three succeeding decades large collections of insects, mainly collected by the missionaries in Southern India, especially at Tranquebar, were sent to Europe, so that by the close of the eighteenth century over one thousand species of Indian insects were included by Fabricius in his " Entomologia Systematica " (1792-98). From this date onwards the progress of the study of Indian insects, if not rapid, was at least continuous, as is shown by an inspection of the numerous entomological publications issued in the nineteenth century, and which contain a vast amount of scattered descriptions of, and information regarding, Indian insects, mostly based on collections made in India by enthusiastic amateurs and sent to Europe. Towards the end of the nineteenth century a considerable volume of work began to be produced in India itself, and such pieces of work as Atkinson's papers on Rhynchota and his Catalogues of Indian Carabidæ and other groups of Coleoptera, published in the *Journal of the Asiatic Society of Bengal*, together with Cotes' and Swinhoe's " Catalogue of the Moths of India," may be taken as representative of this period. A special series of volumes descriptive of the fauna of India was also undertaken under the direct sanction of the Secretary of State for India and is still in progress, and includes numerous volumes on insects, of which the first issued were on moths (four volumes, 1892-96).

In 1881 Blanford published, in the *Journal of the Asiatic Society of Bengal*, a numerical enumeration of the known fauna of India and estimated the insects at about 12,000. In 1909 Lefroy attempted a similar census in *Indian Insect Life* and enumerated 29,700 species, but the figures for many groups were certainly under-estimated. It is safe to say that up to the present year (1917) not less than 35,000 different described species of insects are known to occur within the limits of the Indian Empire, and every year sees several hundreds of additions to the list, whilst in addition our knowledge of previously described species is yearly augmented. The foregoing figures, of course, refer only to definitely described species, but no groups are yet known completely, and many have scarcely been collected and are practically altogether unknown. The progress made during the last two or three decades has been rapid, and a few examples may indicate this. Twenty-five years ago only four species of mosquitoes were known from India; to-day, due to the interest taken on this group on medical grounds, upwards of two hundred species are known. Cotes' and Swinhoe's " Catalogue of the Moths of India " in 1889 enumerated 225 species of Microlepidoptera; in 1917 we know well over 2,000, and hundreds of novelties are turned up every year. It is scarcely possible even to estimate how many forms of insects actually exist in India, but a very moderate computation would place the number at not less than 70,000 as under:—

Lepidoptera	20,000
Coleoptera	25,000
Orthoptera	3,000
Neuroptera	1,000
Hymenoptera	10,000
Diptera	6,000
Rhynchota	5,000
	70,000

I quote these figures because they may possibly assist to make a non-entomologist realise, if only slightly, the magnitude of the work before us as students of entomology in India. There is, unfortunately, a common but erroneous idea, presumably due to the fact that insects are small animals, that entomology is a small subject of minor importance, and it is not at all unusual for comparatively well-informed people to assume that any entomologist must necessarily be able to name off-hand any insect and generally to know everything about every different species; whilst the fact is that as yet we cannot claim to know everything about even the commonest insects, and no one worker can pretend really to know anything more than one small section of the science as a whole. A man who has spent years on the study, for example, of Indian birds, which total not more than 2,000 species, is not usually expected to be proficient in several dozen other sciences of equal magnitude; yet this is usually taken as a matter of course in the case of a student of any branch of entomology.

We may now consider briefly the progress made in entomology by Government employés in India.

Work in India.

Indian Museum.

2. Entomology, principally the formation of a collection of insects and their systematic classification, has always formed part of the general zoological work carried on by the Indian Museum. In 1884 and 1885, Mr. Wood-Mason, at that time Superintendent of the Museum, published reports on "The Tea-Bug and Tea-Mite of Assam" and on the "*Paraponyx oryzalis*, an insect pest of the rice plant in Burma," and from time to time furnished to inquirers such information as was then available on injurious insects. In 1888, Mr. E. C. Cotes took up an investigation of the wheat weevil, and the Trustees of the Indian Museum then decided that the work of identification of the crop-pests of India should be taken up as a part of the work of the Museum staff; Mr. Cotes, then Deputy Superintendent of the Museum, carried on this work, the results being published in *Indian Museum Notes* on Economic Entomology, of which five complete volumes were published between 1888 and 1901. By the latter year the entomological work had grown to an extent which necessitated a change of policy, and in 1901 the post of Entomologist to the Government of India was instituted and filled by the appointment of Mr. L. de Niceville. Up to 1900 the work of the Museum had been confined to receiving and to reporting on specimens sent in, but Mr. de Niceville was appointed to carry his investigations into the field and to study crop-pests, not only in the Museum but in the actual areas of their occurrence. Unfortunately, in December 1901, Mr. de Niceville died of fever contracted in the Darjeeling Terai, which he had visited to study mosquito-blight of tea. An additional part (Volume VI, part 1) of *Indian Museum Notes* was issued in 1903 by Mr. E. P. Stebbing, when officiating as

Superintendent of the Indian Museum, but no further parts were issued, as the post of Entomologist to the Government of India was subsequently transferred from the Museum to the Agricultural Department. The entomological work at the Museum remained practically in abeyance until 1909, when a new post of Assistant Superintendent in Entomology was created and filled by the appointment of Mr. F. H. Gravely, who still holds it, and who has done valuable work on the systematics of certain groups of Coleoptera and Arachnida. The Museum staff for entomology, however, only comprises one Assistant Superintendent and a small staff of subordinates, and is quite insufficient in itself to deal with the study of even the systematics of Indian insects

A few insects are exhibited in most of the Government and local museums throughout India, but few of these institutions have any member of their staffs with any entomological knowledge.

Agricultural Department.

3. After the death of Mr. de Niceville in 1901 it was decided to transfer the post of Entomologist to the Government of India to the Agricultural Department, and Mr. H. Maxwell-Lefroy was appointed in 1903 and stationed at first at Surat, specially for the study of cotton pests. About two years later, on the reorganisation of the Agricultural Department, Mr. Lefroy was transferred to Pusa, and the title of the post changed to that of Imperial Entomologist to the Government of India. The expansion of the work soon led to a necessary expansion of staff, leading to the creation of two new posts, those of Second Imperial Entomologist (to deal specially with biting insects) and of Supernumerary Entomologist, which were filled by Messrs. F. M. Howlett and C. W. Mason, respectively. There has been no further increase in the superior staff at Pusa, although the work is constantly expanding, but in 1912 Mr. Howlett's title was altered to that of Imperial Pathological Entomologist, a change which indicated more precisely the line of his work (*i.e.*, the study of insects carrying disease to man and animals). Subsequently, the Medical Department appointed its own entomological staff for the study of insects carrying human diseases, leaving the study of insects carrying animal diseases to the Imperial Pathological Entomologist.

The provincial Agricultural Departments also have found it necessary to take up the study and control of insect pests and to have their own entomological staffs for this end. The proposals put forward in 1905 (see paragraph 11 of Mr. Sly's note of 16th January 1905) provided for a qualified entomologist in each province, but this was negatived by the Secretary of State. All the provinces, however, have one or more entomological assistants, whilst Madras has had a Government entomologist since 1912, and an entomologist has also now been sanctioned for the Punjab.

The original idea underlying the creation of provincial entomological staffs was that they were appointed to assist the Imperial Entomologist in the collection in their provinces of information respecting insects, and that their work was to be in direct touch with, and under the control of, the Imperial Entomologist. This is borne out by the following extract from the *Proceedings of the Board of Agriculture* for 1905 (page 15) :—

> "The training of provincial assistants to assist the imperial experts in special branches of work such as entomology is recognised by the Board as being of great practical utility."

The fact of their isolation and in some cases the jealousy of the provincial departments, combined with the instructions contained in Government letter No. 188—12-16 of 26th January 1906 that "each imperial expert must bear in mind that he has no authority over the provincial experts, and that his functions in relation to them are purely advisory," have however, in many cases, led to unfortunate results in the quality and outturn of the work of these provincial entomological staffs. I consider that the policy of isolated provincial Entomological Assistants has been a failure, and that the failure has been due directly to the policy of decentralisation.

The present entomological staff of the Agricultural Departments is as follows :—

At Pusa.

Entomological Section.		*Pathological Entomological Section.*	
Imperial Entomologist .	One.	Imperial Pathological Entomologist.	One.
Supernumerary Entomologist	One (vacant since 1915).	Assistants	Three.
Assistants	Four.	Fieldmen, Clerks, etc.	
Sericulture Assistant . .	One (tempy.)		
Fieldmen, Clerks, etc.			

In the Provinces.

Madras.—One Government Entomologist, 3 Assistants, Fieldmen, etc.

Bombay.—Two Assistants.

Central Provinces.—Two Assistants.

Bihar and Orissa.—Two Assistants.

Bengal.—One Entomological Collector.

Assam.—One Assistant.

Burma.—One Assistant

United Provinces.—One Assistant.

Punjab.—One Government Entomologist (post sanctioned; not yet filled); two Assistants.

Besides the above, Mysore has two Entomological Assistants and Baroda and Travancore one each.

At Pusa have been brought together large collections of insects of all orders from various parts of the Indian Empire (especially of crop-pests from the plains of India) and of records of occurrence, damage, etc., of crop-pests. The life-histories of many hundreds of Indian insects have also been investigated and published in over 200 coloured plates, in Lefroy's "Indian Insect Pests" and "Indian Insect Life" and Fletcher's "South Indian Insects," and in departmental memoirs and bulletins and in other publications. Special branches, such as insecticides, sericulture, apiculture and lac culture, have also been taken up and publications issued on each subject. There is also at Pusa a large (though by no means complete) library of entomological literature.

Each of the provincial Agricultural Departments has also formed collections of insects, records of occurrence of crop-pests, etc., and most have issued short bulletins or leaflets on pests of local importance. Except in Madras (where the library at Coimbatore, though small, contains a few entomological books mainly selected as supplementary to those in the Pusa library), there are at present no entomological libraries in the provinces.

Veterinary Department.

4. In spite of the importance of the study in India of the various insects (including ticks, etc.) carrying diseases of animals, there has hitherto been no special entomological staff appointed for this work except the pathological entomological section at Pusa, which for the last three or four years (since the separation of the medical side of the work) has been nominally more or less restricted to veterinary work. In 1914 the services of an Entomological Assistant were placed at the disposal of the Imperial Bacteriologist for an investigation of the insects playing a part in the transmission of *surra,* and a report of the results was sent to Muktesar, but has not yet been published. Considerable collections of cattle flies and of flies causing *myiasis* in domesti-

cated animals have been accumulated at Pusa, but have not yet been worked out. Considerable information has also been brought together on the life-histories and habits of biting insects, and there is also the nucleus of a library on this subject.

Medical Entomology.

5. The great importance of insects as carriers of disease has only been realised within comparatively recent years, but a good deal of work on this subject has been done in India by scattered workers, especially in connection with mosquitoes, ticks and blood-sucking flies, and much of this work is necessarily purely entomological, being concerned solely with the life-histories, anatomy and systematic discrimination of insects. As examples, it is only necessary to mention here the general work on mosquitoes (including numerous Indian species) by Giles and by Theobald, with the later revisions and additions by Edwards, and numerous papers on biting flies by Austen, Ricardo, etc. In India itself the study of biting insects (especially mosquitoes) has been taken up by numerous medical officers, as is witnessed by such publications as James' and Liston's Monograph on the Anopheline Mosquitoes of India, by several scientific memoirs of the Medical and Sanitary Departments, by Christopher's papers on mosquitoes, and by Patton and Cragg's "Text-book of Medical Entomology." The work, however, has suffered to some extent from want of precision owing to the want of expert entomological knowledge on the part of some of the workers—I do not mean to say that their results have been inaccurate, but that in some cases there has been apparent a want of familiarity with ordinary entomological usage regarding such matters as definitions, descriptions and nomenclature—and to a far greater extent by a want of continuity, whereby the few men capable of doing entomological work have not always been retained in posts where they could apply their talents to the best advantage.

Three or four years ago a medical entomologist (Mr. Awati) was appointed, but this post is, I believe, held under the Medical Research Fund, and is not, strictly speaking, a Government appointment.

In view of the extensive incidence of insect-borne diseases in India, it seems clearly necessary that the study of medical entomology should be placed on a proper footing, and that medical officers in India should be afforded adequate and competent assistance in the investigation of such insects. As Sir Pardey Lukis has recently written (*Indian Journal of Medical Research, IV, 386; January 1917*):—

> "The flies of India, both blood-sucking and non-blood-sucking, the parasitic ticks, ... the larvae-destroying fish and other enemies of the mosquitoes .... offer ample scope for research to the entomologist."

With the help of a strong entomological staff working in close touch and collaboration with the Medical Department, it may be said with confidence that a very great advance in the control of insect-borne diseases in India may be expected.

Forest Entomology.

6. The pages of *Indian Museum Notes* (already referred to) contain numerous references to insects attacking forest trees, but it was not until 1900 that a post of Imperial Forest Entomologist was sanctioned for the study of Indian forest insects. In 1906, after the creation of the Forest Research Institute at Dehra Dun, the title of the post was altered to that of Forest Zoologist. The appointment has been held by the following officers :—

1900-1909	Mr. E. P. Stebbing.
1910	Mr. V. S. Iyer (*pro tem.*)
1911	Mr. R. S. Hole (*pro tem.*)
1911-1913	Dr. A. D. Imms.
1913	Mr. C. F. C. Beeson.

The staff comprises also two assistants, two collectors, one setter, one artist, three clerks and four peons.

I am indebted to Mr. Beeson for the following notes:—

"Buildings.—In the Forest Research Institute, completed in 1914, are the offices (clerks' room, record room, and Zoologist's office room), and the museum. In two detached buildings in the Research Institute grounds are the insectary and laboratories, etc.

"The museum is a well-lighted room, 92′ × 32′, containing a collection as yet in its early stages. It is mainly entomological and exhibits a good series of forest insect pests with examples of their work, there is a small but growing collection of birds and of reptiles, and of shikar trophies.

"The laboratory building consists of four rooms, two of which are laboratories 26′ × 15′ and 18′ × 15′, while the other rooms, 18′ × 32′, are used respectively as library and insect-collection room. In the latter the systematic collection and spirit material is stored; teak wood store boxes with bases of cork or naphthaline in paraffin wax are in use, contained in dustproof teak almirahs. Collections and library are card-indexed.

"The insectary is a one-roomed building, built on the Pusa pattern after designs by Dr. Imms. The main room is 41′ × 28′, to which are attached on three sides a series of out-door cages with raised soil pits in which saplings of forest trees can be grown. The east and west cages measure 12′ × 7′ and are enclosed on three sides and above with 1/22″ mesh galvanised wire-gauze in an iron frame-work. The six cages on the south side measure 7′ × 6′, and two central cages are roofed with plate glass and have cement-plastered walls. Access is gained to them by double doors from the interior. Gas and water are laid down and the building is isolated by means of an ant-gutter.

"The indoor breeding cages are mostly adapted for the breeding of woodborers over long periods, and are light-tight with emergence-traps on American patterns. Evaporators of coarse pottery are used to maintain even humidity and postpone shrinkage of the logs. Defoliators are usually reared in open Fiske trays, and root-feeders in gauze cylinders in the soil pits.

"Times of investigation.—A three-year programme of research is drawn up at the triennial meeting of the Board of Forestry, based on suggestions brought forward by the Forest Departments of the several provinces. The present investigations deal chiefly with the insect pests of three principal forest trees, *sal* (*Shorea robusta*), teak (*Tectona grandis*), and the Himalayan conifers (*Pinus longifolia, Pinus excelsa, Cedrus deodara*). The enquiries are carried out by the research officers in prolonged tours extending over about eight months of the year. There are no field stations, but in a few cases observation areas in the forest have been started for pests which cannot be established in the insectary. The limited staff, however, prevents very extensive enquiries being carried out.

Special problems.—The enquiries with regard to the majority of pest species have not yet passed the initial stages, but, where life-histories are well-known, effective control measures have been devised in a few cases only. The absence of intensive management, the disproportionate value of the crop; and impossibility of early recognition and location of insect attack prevent the adoption of many of the control measures in force in European forests. An exception can be made in the case of nurseries, young plantations, where intensive cultivation and supervision occurs, and in the case of bark beetles in the coniferous forests of the Himalayas, which are successfully controlled by measures based on European methods. The chief problems lie (*a*) in the discovery of methods of checking damage by heart-wood borers, especially those species which are sporadic in habit and attack isolated trees here and there, and (*b*) in the prevention of widespread defoliation which occurs annually in many types of deciduous forests."

A considerable volume of work on forest insects has been published during the last fifteen years, but a large proportion of the earlier work was very incomplete and in many cases inaccurate, thus requiring revision. Forest entomology in India has also been handicapped considerably by the dislocation necessarily produced by the numerous changes of staff which have taken place. Generally speaking, it may be said that the work of the Forest Zoologist is purely entomological and deals with insects in many cases identical with, and in nearly all cases closely allied to, those dealt with by the entomological staff of the Agricultural Department, so that there seems to be no necessity for the separation of this work between two departments.

Other entomological work in India.

7. Besides entomological work carried on under the Government of India and the Local Governments, there is a certain amount of work done by Native States and un-official workers. Baroda, Mysore and Travancore, for example, maintain entomological assistants attached to their Agricultural Departments, whilst the Bombay Natural History Society has a small collection of insects and helps to bring together amateurs and others by means of entomological papers published in its journal.

The Indian Tea Association also maintains an Entomologist (Mr. E. A. Andrews), with a small staff, to work solely on insects affecting tea estates in north-eastern India, but, whilst the study of tea insects is rather specialised as regards some of the worst pests, it may be pointed out that many pests of tea attack other crops (and *vice versâ*), and also that lately, owing to the extension of the practice of growing leguminous crops as green manure and to prevent erosion on tea estates, the work of the Entomologist to the Indian Tea Association has necessarily been extended to comprise the pests of such crops, which are also necessarily studied by the entomological staff of the Agricultural Department in other (non-tea) areas. In southern India also, where there is a considerable acreage under tea, it is part of the duty of the Deputy Director of Agriculture in the planting districts (Mr. R. D. Anstead) to advise the planters on the subject of insect pests of tea, coffee, rubber, etc., and this is done mainly in co-operation with the Imperial Entomologist, with whom Mr. Anstead keeps in touch. Thus, even as regards only tea-pests in India, there is no one individual or body to study them as a whole.

Numerous residents and visitors also take an active interest in entomology, although their energies are mostly confined to the more conspicuous and popular groups of insects, such as butterflies. However, it is largely owing to the enthusiasm of such amateurs in the past that the study of entomology in India has attained its present proportions, and hence it is necessary to include their activities in any general résumé of the subject.

Necessity for considering work outside of India.

8. The horizon of the ordinary Government servant in India is usually limited to his own district or province, but insects have no respect for political boundaries. Many of our worst pests, indeed, are practically world-wide in their range, and the entomological worker must, therefore, if his information is to be adequately complete, study the habits and control of such pests throughout their whole area of distribution and keep himself abreast with all information published concerning them; incidentally, it may be pointed out that this requires ability to read all the principal European languages. The insect pests of Ceylon, for example, are practically identical with those of southern India, and the same may be said to a less extent of those of the Malay Peninsula, Java, Queensland and Formosa, all of which maintain expert entomological staffs, whilst the habits and control-methods of insects in other parts of the world often afford most valuable hints regarding these points in India, even in cases where the insects are not exactly identical. The extra-Indian breadth of view required of an entomological worker in India is a point which is usually little realised by the non-entomologist and, therefore, requires to be emphasised here. It may also be pointed out that much of our most important work on Indian insects, including the preparation of most of the volumes in the *Fauna of British India* series, has been done outside of India.

Summary of foregoing.

9. The above statement shows in very brief outline in what various directions entomology is being carried on in India, and it will at once be apparent that the official work is distributed over at least four services (Forests, Medical, Museums, Agricultural and Veterinary), all independent of one another and

not even under one department of Government. Many insects and groups of insects are pests common to both forest trees and agricultural crops, many others are carriers of disease both to man and animals, whilst the systematic side of the work, which is nominally confined to the Museums branch, must form the very foundation of all advance by economic workers in each of the other branches. There is thus a great amount of unnecessary overlapping, expense and waste of work, as each worker must maintain his own collection, library, records, etc., many of the items of which must also be set up and maintained by other workers in each different service, and indeed (as things are at present) by each worker in each appointment. Each worker in the Agricultural, Forest and Museums Services, for example, has to maintain a series of insects in all orders, which means that he has to waste a large amount of time in identification of groups with which he is not personally familiar, although they may be represented and named up in other collections in India, and to obtain such identification requires a large amount of time, trouble and correspondence with specialists in each of such groups, whilst conversely each such specialist suffers from the disadvantage of seeing scattered small lots of specimens instead of being able to examine a large mass of material, which is usually (it may be pointed out) far more satisfactory to work out. There is also the further disadvantage that the same species may be sent by different workers in India to different specialists at the same time, thus leading to unnecessary synonymy and trouble for future workers.

Conclusions.

10. It will be seen from the above summarised statement that, although considerable progress has been made towards the study of entomology in India, this science has hitherto suffered from the scattered and haphazard way in which such studies have been prosecuted, at first by (*a*) professed (though not in many cases professional) entomologists outside of India, each working primarily on a special group of insects, and (*b*) in India itself mostly by enthusiastic amateurs who have provided the material for the workers noted in (*a*), and who have also contributed by their observations to a knowledge of the habits and life-histories of those insects which they met with in India. Even later on, in recent years, when the study of Indian insects has been taken up by whole-time employés of Government, it will be seen how scattered and inco-ordinated such work has been, the various workers in the Agricultural, Forest and Medical Departments and the Indian Museum each confining his attention and devoting his energies to work in his own particular line, with little regard to what has been done by other workers in India. It may be said, indeed, and with considerable accuracy in my opinion, that such is the logical outcome of the present policy of isolation of the different entomological workers who are, so to speak, shut off from one another by the water-tight compartments artificially set up by the separation of the various departments under which they are working. This is, I know, a matter of general policy and perhaps rather outside of the present case, but it is necessary to consider it now, because, in my opinion, the time has come when Government should definitely make up its mind regarding the continuation and expansion of the present work in entomology and the most efficient means of securing such. It is not a question of one or two men or a few thousand rupees in this or next year's budget. It is our duty *now* to lay a firm foundation which will endure permanently, so far as we can foresee, and which will not require to be scrapped or changed in any essential particulars during the present century; otherwise we are wasting our own time and failing in our duty to our successors. The question is, how can we best provide now for the requirements, not only of our own time, but of the future? And to this question there are, it seems to me, only two possible answers, which may be

summed up in the words (*a*) centralisation, and (*b*) decentralisation. We have now to consider the respective merits and demerits of these two propositions.

(*a*) Centralisation.—A centralised scheme will provide for one main institute and a body of workers all belonging to one service. All the workers will be working on one subject, though not necessarily on the same branch. Each worker will be able to devote his time and energy to his particular object knowing that other workers, with whom he will be in touch as belonging to the same service, are also working at other similar problems, and that their information is freely at his service as his is at theirs. Government officials and the general public equally will know exactly where to apply for information regarding any matter concerning insects, and the best information available can be supplied either from the central institution's records or from the entomological worker best able to reply from his special knowledge. As regards the entomological workers, also, a centralised scheme will allow for recruitment of suitable candidates for the employment of entomologists on work for which each is best suited, both as regards aptitude for particular kinds of work and for employment in the field or at the central institution with some regard to personal fitness, for problems connected with leave and various cognate matters. As regards such questions as legislative restrictions regarding insect pests, it is obviously desirable that such should be handled by a central institute. As regards the central institute itself, a centralised scheme will secure economy in buildings and in all expenses necessarily entailed in the acquisition, accommodation and upkeep of collections, library and records, while there will be, further, the inestimable advantage of having one general collection of insects and entomological literature and records for the whole of India, under which conditions it will be possible for the first time to aim at a tolerable degree of completeness in each. A strong plea must also be entered for the centralisation of publications (at least of entomological ones as such), especially as regards other workers on cognate problems outside of India.

All the above may be, and in my opinion are to be, described as merits of a centralised scheme.

As regards the demerits of such a scheme, the following have occurred to me:—

(1) The difficulty at present of providing a sufficient staff of entomological workers: this however, is a difficulty which will apply to any scheme for expansion and one, moreover, which will solve itself in course of time, and it may only be noted here that the larger the staff and the higher their reputation, the less difficulty is there likely to be in attracting sufficient candidates of the right stamp.

(2) The practical difficulty of attending to purely local inquiries (such as small outbreaks of crop-pests) or local problems (such as education in provincial Agricultural or Forest Colleges) without having such an overwhelmingly large staff that centralised control would become inefficient: I fully recognise this difficulty and propose to overcome it by restricting the proposed centralised scheme to a high-grade service of entomological workers, engaged mainly (if not solely) in research work, as explained in detail later on.

(*b*) Decentralisation.—I fail to see any particular merits in a decentralised scheme, whereby each department has its own separate entomological staff as at present, so far at least as this remark applies to the higher-grade research workers. There may be a certain amount of *amour propre* on the part of such departments or their heads, in the idea that they are self-contained, but we are concerned with efficiency and not with sentiment. There may also be red-tape objections to a centralised scheme on the ground of budget allotments to particular Governments or provinces or departments, but very little readjustment is really required.

The demerits of decentralisation are numerous and cogent and include :—

(1) Waste of time by the necessity of each separate worker having (*i*) to spread his energies over a wide field instead of settling down to one piece of research, (*ii*) to go over an enormous volume of current literature merely to see whether there is anything affecting his own work.

(2) Overlapping of work due to the fact that there is no real dividing line between, for example, insects affecting many forest trees and agricultural crops, so that both the Forest and Agricultural Entomologists must study the same insects. This, of course, is more pronounced still in the case of, say, half-a-dozen Agricultural Entomologists in as many provinces, in all of which the same insects may occur on the same crops. Of course, there is the advantage that different workers may proceed on different lines and one succeeds where another fails, but the waste of labour due to overlapping more than compensates for this. In this question especially it is necessary to look ahead.

(3) Waste of public money by the absolutely necessary provision of accommodation (laboratories, insectaries, collections, staff, etc.), libraries and other expenses for each worker.

(4) The publication of results in a mass of scattered literature, which makes it much more difficult for present and future worker to know where to find information on any particular subject.

Entomological progress outside of India.

11. Having briefly considered the merits and demerits of centralised and decentralised schemes as applied to the present and future requirements of entomological work in India, we may briefly review the experience gained in some other countries in which entomology has progressed in recent years. In this connection I shall omit consideration of European countries because, comparatively speaking, their entomological problems and staffs are alike of small importance.

The United States of America.

12. The United States of America have justly attained a world-wide reputation through the organisation and efficiency of their Agricultural Department, and their entomological problems are dealt with by the Bureau of Entomology under the able leadership of Dr. L. O. Howard.

The Bureau of Entomology (as described in the United States Department of Agriculture Year Book for 1908, page 495) "obtains and disseminates information regarding injurious insects affecting field crops, fruits, small fruits, truck crops, forest and forest products, and stored products ; studies insects in relation to diseases of man and other animals and as animal parasites; experiments with the introduction of beneficial insects and with the fungus and other diseases of insects ; and conducts experiments and tests with insecticides and insecticide machinery. It is further charged with investigations in apiculture. The information gained is disseminated in the form of general reports, bulletins and circulars. Museum work is done in connection with the Division of Insects of the National Museum, and insects are identified for experiment stations and other public institutions and for private individuals."

The Bureau of Entomology is divided into at least ten sections, of which eight are concerned with researches on plant pests. Their budget for the year 1913 (the latest year‡ of which I have particulars) was Rs. 20,64,750* and thier staff comprised 207 members. The sections dealing with plant pests are :—

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* I have reckoned three rupees to the dollar.

‡ *Later Note.*—The budget for the year ending 30th June 1918 is Rs. 27,94,440.

1. Researches on pests of deciduous fruit trees, with a staff of 16 experts and a budget of Rs. 1,39,800.
2. Researches on pests of cereals and fodder crops, with a staff of 42 experts and a budget of Rs. 2,76,600.
3. Researches on insect pests of the southern crop districts, with a staff of 24 experts and a budget of Rs. 1,54,800.
4. Researches on forest insects, with a staff of 36 experts and a budget of Rs. 1,67,850.
5. Researches on pests of truck crops and stored products, with a staff of 20 experts and a budget of Rs. 1,12,200.
6. Researches on tropical and sub-tropical fruits, with a staff of 7 experts and a budget of Rs. 64,500.
7. Researches on Mediterranean fruitfly, with a staff of 2 experts and a budget of Rs. 10,500.
8. Researches on gipsy and brown-tail moths, with a staff of 36 experts and a budget of Rs. 9,09,000.

Other sections deal with :—

9. Insects carrying diseases of man and animals, and
10. Bee keeping,

but I have no definite information regarding their staffs or budgets.

In addition to the Bureau of Entomology many of the States maintain their own entomological staffs, and of course all the principal Universities have their professors of Entomology (several in some cases, as at Cornell University), but it may be said without hesitation or fear of contradiction that it is mostly owing to the centralised activities of the Bureau of Entomology that the United States have come to occupy a position in the very forefront of entomological progress.

Canada.

13. In Canada, the first Dominion Entomologist was appointed in 1884 by the Minister of Agriculture on the recommendation of a Select Committee and in accordance with recommendations from various parts of the Dominion, and the late Dr. James Fletcher was appointed, the position being an honorary one for the first year. In 1886, when the Dominion experimental farms were established, Dr. Fletcher was attached to the scientific staff of that branch as Entomologist and Botanist, in which dual capacity he served until his death in 1908. The increase of all lines of work necessitated the separation of these two offices, and in 1909 Dr. C. Gordon Hewitt was appointed Dominion Entomologist and, with one assistant, was entrusted with the work of organising the new Division of Entomology. In April 1914 the entomological work of the Dominion Department of Agriculture was separated from the Experimental Farms Branch and was constituted as a separate branch of the department. The work of the Entomological Branch includes :—

(*a*) the working of fumigation stations and of various legislative enactments to prevent the introduction of dangerous pests from abroad and to control those already imported,

(*b*) the fumigation of nursery stock,

(*c*) the suppression of brown-tail moth, San José scale and other serious pests,

(*d*) the working of field laboratories for the local investigation of various destructive pests. In 1916 these laboratories totalled nine, in addition to two sub-stations, and provided for both agricultural and forest pests, (*e*) the deputation of trained men from these laboratories to cope with outbreaks of pests when these are reported,

(*f*) special investigations on forest insects, fruit insects and pests affecting field, garden and cereal crops,

(*g*) special investigations of insects carrying diseases of man and animals,

(*h*) the building up of a national collection of Canadian insects,

(*i*) the dissemination of information regarding insects by publications, exhibitions and addresses,

(*j*) apicultural work (for the present this remains under the Experimental Farms Branch).

The aims of the Entomological Service are briefly defined by Dr. Gordon Hewitt as:—

> " first, the prevention of the introduction and spread of injurious insects, second, the investigation of insect pests affecting agriculture, horticulture, forestry and the health of domestic animals and man; and third, the imparting of the information so obtained to those interested and concerned by means of bulletins, circulars, press notices, addresses, letters, and personal visits. For these purposes there exists at Ottawa and at the various field laboratories throughout the country a staff of men of such scientific training and ability as will enable them to make the service of the greatest benefit to the people of Canada.

It may particularly be noted that all the work of the Canadian Entomological Service is directed from Ottawa by the Dominion Entomologist.

In addition to the foregoing, Ontario, Nova Scotia and Quebec have also provincial Entomologists. " In the other provinces of Canada, no provincial entomologists have been appointed, and where entomological investigations are being conducted they are in connection with one or other of the Dominion field laboratories. Where Dominion and provincial officers are carrying on investigations in the same province, the heartiest co-operation is enjoyed, and arrangements are made with a view to preventing duplication of the work and consequent loss of energy. In certain cases investigations are being conducted conjointly, and this spirit of co-operation is most valuable, especially in its relation to the attitude of the public towards the work." (*Annals Entom. Soc. America*, IX, pages 24-25, 1916.)

South Africa.

14. In South Africa, prior to the formation of the Union of South Africa, the four colonies (Cape Colony, Natal, Transvaal and Orange River Colony) carried on their entomological work independently. Cape Colony was the most advanced and in 1895 had created a Division of Entomology with Mr. C. P. Lounsbury as Chief. Following on the Union, Mr. Lounsbury was made Chief of the new Division of Entomology of the Union Department of Agriculture, with headquarters at Pretoria. The work of this division comprises, in addition to the dissemination of advice on insect problems and the carrying on of investigations, the administration of Government regulations concerning (1) the suppression of locusts, (2) the inspection of nurseries, (3) plant and fruit imports, and (4) restrictions on the conveyance of plants and fruit. Mr. Claude Fuller, formerly Entomologist in Natal, is also stationed at Pretoria as Assistant Chief, together with a staff of other workers. There are also branch laboratories at Cape Town, Bloemfontein, and New Hanover (Natal), and in addition to the staffs at these laboratories, plant inspectors are stationed at the following ports of entry for plants and fruit, *viz.*, Capetown, Johannesburg, Durban, East London and Port Elizabeth.

Australia.

15. In Australia the Commonwealth Government did not, on its formation about sixteen years ago, assume any jurisdiction over agricultural matters, but left the individual States in full control. There is, therefore, no entomological work undertaken by the Commonwealth Government beyond the administration of the Federal Quarantine Act, which regulates the importation, etc., of

plants into the country; this Act, I understand, is administered by the Customs Department.

A result of the absence of any central control over entomological work in Australia is seen in the scattered and inco-ordinated work which is being done there. New South Wales has a Government Entomologist (Mr. W. W. Frogatt), but considerable work on the investigation of disease-carrying insects is also carried out by the Government Bureau of Microbiology, whilst a large staff of inspectors, employed in different districts to see that spraying regulations, etc., are carried out, apparently work under the Agricultural Department directly. In Victoria the Entomologist (Mr. C. French) apparently devotes most of his time to the administration of the Fruit and Nursery Inspection ordinances, and little work of an investigatory character seems to be carried on. In South Australia the entomological work is carried on by the Horticultural Division of the State Department of Agriculture, at Adelaide; nursery inspectors are employed to carry on a campaign against fruit pests (codling moth and scale insects), but there appears to be no definite Entomological Division. In Queensland there has been a Government Entomologist (Mr. H. Tryon) since 1897, with headquarters at Brisbane, but little original work seems to have been done in the last ten or fifteen years; there is a special field station at Gordonvale, near Cairns, for the investigation of sugarcane insects, but I am not aware that any entomologist has yet been appointed or any work actually done. At the Tropical School of Medicine at Townsville also, Mr. F. Taylor has carried on some excellent work on blood-sucking Diptera, especially *Calicidæ* and *Tabanidæ*. Western Australia has since 1898 maintained an entomologist (the present officer being Mr. J. L. Norman) with headquarters at Perth, but little work seems to have been done beyond supervision of imported vegetation and of the nurseries in this State. The Northern territory has an entomologist (Mr. G. F. Hill), stationed at Darwin, who has done some work on termites and on the relation of blood-sucking flies to the transmission of parasitic nematode worms. In Tasmania there seems to be no regular entomological service, but advice on the control of insect pests is given by the Fruit Expert.

Other countries and British Possessions (such as Rhodesia, Uganda, British East Africa, Egypt, Sudan, British West Africa, Ceylon, Fiji, New Zealand and the West Indies) have also their own entomological staffs, but it is unnecessary to refer to these here. Those I have already described have been selected because they are representative of countries (equally with India) (*a*) comprising large areas under very diverse climatic conditions, and (*b*) with a Supreme Government combined with local Administrations. The United States, Canada, and South Africa unite in the possession of a centralised entomological staff working in conjunction with provincial staffs, whilst in Australia the entomological staffs are purely provincial and decentralised. It seems to me a significant fact that, whilst in the United States, Canada and South Africa the entomological work accomplished is universally acknowledged as of excellent quality, that being done in Australia can only be described (with a few exceptions) as indifferent.

From a consideration, therefore, both of our own requirements in India at the present time and to admit of expansion in the future, and from a comparative study of the methods found most efficient under somewhat parallel conditions in other parts of the world, I am strongly of opinion that all the higher-grade entomological work in the Indian Empire should be carried out by a staff of entomological specialists, included in one Entomological Service, and attached to one Central Entomological Institute.

Proposals for an Indian Entomological Service.

16. It now remains to consider the means by which the above suggestion may be carried out, and these may be considered under the headings of (*a*) Staff and (*b*) Buildings, etc.

(*a*) Staff.

Entomological Service.

As indicated above, the present workers on entomology in India are scattered amongst the Agricultural, Forest, Medical and Museum Services in India, whilst there are also entomologists working under the Indian Tea Association and Medical Research Fund. These latter are not Government servants, strictly speaking, but practically are so, because their employers are receiving Government subsidies, without which they would be unable to maintain their staffs. The present system leads to want of co-operation between these various workers, and it appears clearly desirable that all workers in this one subject should be in one service. At the same time, I do not consider that it would be practicable to unite these men in any of the existing services, as such a course would inevitably lead to a feeling of inter-departmental jealousy and possibly friction, as the workers would necessarily tend to get out of touch with departments other than the one to which they were attached. I recommend, therefore, that all the workers be placed in one service, to be called the Indian Entomological Service, separate from any of the existing services to which the Entomological Service would be co-ordinate but not subordinate. As regards the department of Government under which the Service would come, pending the creation of a special Scientific Department of the Government of India—a department which, I venture to predict, will come into existence within the next fifty years—it seems a matter of indifference whether the service should be placed under the Department of Revenue and Agriculture (already represented by the Agricultural and Forest Entomological Sections) or under the Department of Education, which controls the Medical and Museum Departments, but on the whole, as matters are at present, it would perhaps be better to place it under the Revenue and Agriculture Department in the same way as the Agricultural and Forest Services. I do not anticipate any large increase of secretariat work as the result of this proposal, and it must also be remembered that the cadre of the Entomological Service will not represent any great increase in actual number of Government servants, but only a centralisation of the total numbers instead of scattered items, *e.g.*, of budgets, etc.

The Indian Entomolgical Service should comprise two classes of entomological workers, together with the subordinate staff usual to every service.

Class I to consist wholly of entomological experts, that is to say, of qualified entomological workers, each an expert in his own line, to devote their time purely to research work either in the laboratory or the field. The pay would depend largely on the special qualifications of each man, but should conform roughly to a scale of Rs. 500—50—1,500. As each expert should be a specialist in his own particular line, it is very important to be able to select only the very best men obtainable, and to do this and retain such men in the Entomological Service, good terms must be offered. The Entomological Service will have no use for second-rate men except for subordinate posts.

Class II to consist of :—

(1) Assistants. These men to be of much the same grade as those at present employed, *i.e.*, graduates of Indian Universities. They would be

employed in minor investigations under the direction of the experts. Pay to depend primarily on capabilities and work of each man, but to conform generally to a scale of Rs. 50—20—150, Rs. 150—10—300, thereafter rising higher in special cases.

(2) Collectors and setters. Men of less educational acquirements than assistants, their work requiring rather manual dexterity. Their duties would comprise the collection in the field of material required, and its preservation and preparation for the collection and the upkeep of the same under the superintendence of the assistants and experts. Pay about Rs. 20—3—50, with a few higher posts.

(3) Clerical establishment on the usual rates of pay.

(4) Artists. These are absolutely necessary for keeping a proper record of life-histories in the field and for preparation of results for publication. The work is specialised and technical, and only really good men are of any use. Pay about Rs. 30—5—75, with a few higher posts.

17. As regards numbers, the following scheme is intended as a nucleus to commence with and represents the bare minimum with which really efficient entomological work can be carried out in India. At the same time it is capable of expansion in any direction found necessary.

Class I.

Available for definite problems in Agricultural work	6
Available for definite problems in Forest work :—	
One for Himalayan Forests One for South Indian Forests One for Burma Forests	3
Available for definite problems in Medical work	2
Available for definite problems in Veterinary work	1
Stationed at the Central Institute and employed on systematic and life-history work there and available as a reserve for leave and field workers	7
Imperial Entomologist and Director of Central Entomological Institute	1
	20

The numbers shown against each item above must be regarded as approximate only and represent what would probably be the most efficient distribution of workers on a basis of twenty men, which I regard as the minimum number necessary. The allotment of workers to each subject must be based on (*a*) the work to be done in each direction, and (*b*) the men available, but it must be borne in mind that there is no intention of tying down any particular number of men to work on any one line, and also that the work on which any expert is employed must be selected with special regard to his capabilities; one man, for example, may be best employed on administrative work (*e. g.*, pest-control experiments), another on working out life-histories, and another on purely systematic work. The actual allocation of workers to particular duties must be vested in the Director of the Central Institute, and it will be his duty to employ his staff to the best advantage, with due regard to the requirements of the various departments of Government, who will of course be free to indicate any special problems which they consider require special investigation by the Entomological Service. With these remarks, we may now consider briefly the foregoing lines of work.

Problems in agricultural works.

18. It is usually conceded, by those who have studied the subject and are, therefore, in the best position to form an exact opinion, that on an average the outturn of all crops is reduced about ten per cent. by the attacks of insect pests; that is to say, the farmer who obtains what he considers a normal full crop

really only gets ninety per cent. of what he would have got, had there been no diminution due to insect pests. I leave to the Statistical Department the task of working out the value of the annual crop production of the Indian Empire, and will here only estimate roughly that the annual damage thereto by crop-pests cannot be placed at less than five hundred millions (five thousand lakhs) of rupees, and that a reduction of this damage by even one per cent. of the damage now done would more than justify the cost of the most expensive and the best Entomological Service obtainable. I consider that, at least in the case of the more important crop-pests, which do most damage because they attack crops which are grown over very extensive areas in India, the reduction of such damage is most likely to be attained by a thorough investigation of each such pest. It is only when we have a really thorough knowledge of such a pest that we are in a satisfactory position to check it. We must know everything about it, its range of occurrence, its normal and possible food-plants, its exact life-history under every condition, its enemies (and their enemies), and in short all the conditions favourable or unfavourable to its increase. It is only after this thorough investigation of each insect concerned that we are really in a position to evolve a sound scheme of control built up on a firm foundation of adequate knowledge, and to attain such a foundation it is necessary to put whole-time workers on to each problem and to leave them to solve it, unfettered by any other demands on their time, and with the whole help and co-operation of the Central Institute to assist them. Each of these workers on agricultural problems would, therefore, be given a definite piece of work to do, and left to carry it out throughout the whole area of occurrence of the insect concerned, without being tied down to provincial limits; for, as noted above, nearly all the important pests occur over wide areas, and their investigation is therefore not a matter concerning one or two provinces, but all or nearly all. It seems obvious that a body of, say, half-a-dozen workers, attached to a Central Institute, and each free to give his whole undivided attention to one piece of work, would accomplish far more than an equal number of workers, each confined, to all intents and purposes, within the narrow limits of his own province and each relying on his own resources and probably duplicating to a large extent the work already accomplished elsewhere. I do not refer here so much to the practical application of results as to the preliminary investigation of pests which is necessary for the devising of successful means of control, but it may be added that the application of practical means of control of insect pests of crops may usually be left to the staff of the Agricultural Service and, once such control measures are established as a practical routine measure, will not generally require the continuous supervision of an entomological expert, whose services can then be transferred to the investigation of the next problem awaiting solution. The numbers provided for are intended to allow for the taking up of work in applied entomology as regards apiculture and lac culture, so far as the entomological aspects of these subjects are concerned, although as the work expands, it is probable that these subjects may require each a special section. This, however, will work out with the development of the service. I have not provided for sericulture, as I understand that proposals on this subject are now before Government; this also is primarily of importance from the commercial point of view. So far as the Entomological Institute is concerned, however, any information or assistance on the entomological side would of course be given as far as possible.

The present work of the Entomologist to the Indian Tea Association on tea pests would fall under the ordinary scheme of work of the entomological experts employed especially on agricultural work.

Problems in forest work.

19. I have provided, in the above nucleus scheme, for three entomological experts, one each to work respectively in the Himalayan, South Indian and Burmese forest areas, as the predominant trees (and hence their pests) are considerably different in these three areas. It must, however, be understood that this scheme is only a nucleus one to provide for preliminary research on such insect pests. The Forest Research Institute at Dehra Dun already possesses an insectary and laboratory accommodation, and these could doubtless be utilised as a central out-station of the entomological expert attached to the Himalayan Division. The need of an entomologist for the South Indian Forests has certainly made itself felt, and I think that the same may be said of Burma; at least three experts are required, therefore, as a minimum.

Problems in medical work.

20. The importance of insects as carriers of human diseases has forced itself on the attention of all civilised nations during the last two decades, and the necessity for the investigation of such insects in India requires little emphasis here. In this section again it should be realised that the two experts, provided for in the foregoing scheme, are intended as a nucleus only. I would suggest that one of these two experts should be exclusively a mosquito specialist, whilst the other should be primarily a pathologist, able to work on insect-borne diseases from a medical view-point, leaving the more systematic side to his colleagues at the Central Institute.

The mosquito expert would be attached permanently to the Central Entomological Institute, where all systematic work would be done, but would be available for touring to study the life-histories, and occurrence of mosquitoes throughout the Indian Empire and to advise, where required, on problems of mosquito control. The pathologist would keep in close touch with Schools of Tropical Medicine in Calcutta, Bombay and Madras. The work of both men would be arranged by the Director of the Entomological Institute in consultation with the Medical Department.

Problems in veterinary work.

21. Seven-tenths of the population of the Indian Empire are directly dependent on agriculture for their livelihood, and the whole basis of Indian agriculture rests on the cattle of the country; yet in spite of the fact that so many serious diseases of domesticated animals are known to be transmitted by insects (including ticks, etc.), there seems hitherto to have been no definite policy of entomological work in this direction, and very little has been done. At least one whole-time entomological expert is required for this work alone. His work would be arranged by the Director of the Entomological Institute in consultation with the Veterinary Department.

Entomological experts at Central Entomological Institute.

22. The scheme provides for seven men under this heading, and there would be more than ample work for this number merely in working out the collections of insects received from the staff of the Institute working at their several problems in the field and from correspondents in and outside India, in investigation at headquarters of life-histories, etc., of insects, testing of insecticides and general routine work. But the scheme provides for more than this, because, even if the staff is at full strength, there will necessarily be leave vacancies at times, and also an expert who has been working in the field for a year or more on one insect will require to return to headquarters to write up his results and perhaps to have a change of work, and the field work can then be continued (so far as can be done) by sending out one or more of the men from the Central Institute. It will also be necessary to provide (*a*) for purely systematic workers, as some of the recruits available will inevitably turn out to be excellent systematists but indifferent field workers, and (*b*) for men who have reached a time of life when they are not fit for strenuous field work, but when their previous extensive experience will be more valuable at headquarters. In any case, it will be essential to have a strong staff at headquarters, as it is intended

that the field workers should be relieved, as far as possible, of all systematic work, care of collections, correspondence, etc., so that they may give their undivided attention to the problems in hand.

Director of Entomological Institute.

23. As this officer will have to keep in close touch with the various activities of his whole staff and to arrange their work in consultation with all other departments, to keep in touch with all other entomological work throughout the world, and to advise Government on all entomological questions, he must necessarily be an entomologist. He should draw the ordinary pay of his grade as an expert and be given an additional allowance of Rs. 500 per month, in recognition of his increased responsibility and the onerous nature of his duties.

Class II.

24. Generally speaking, each entomological expert working in the field will require the services of assistants, collectors, setters, and artists, but the amount of assistance required by each expert would depend so largely on the conditions of each case that I have thought it unnecessary to draw up any rigid scheme of establishment for each section, as such assistance would be allocated as requisite by the Director of the Entomological Institute. It seems better, therefore, to show these men in one group of figures for each grade.

Assistants.

Available for field work	12
Upkeep of entomological show-cases in museums	1
At headquarters :—	
Records	1
Library	1
Insectary	2
Collections	6
Total	23

Setters and Collectors.

Available for field work under experts	12
Available for field work to be sent out to procure special material	4
At headquarters :—	
For upkeep of collections	6
Insectary setter	1
Printer (for labels)	1
Total	24

Clerical Establishment.

Superintendent of Director's office	1
Head clerk	1
Cashier	1
Clerks and typists	8
Storekeeper	1
Total	12

Artists.

Head artist	1
Artists (available for work under experts in field and at head-quarters)	11
Total	12

Menial Establishment.

Peons (for touring officers and at Central Institute)	24
Estate chowkidars	4
Malis (for estate and insectary compound)	6
Sweepers for Central Institute	4
Total	38

(*Note.*—The above figures do not provide for water supply, electrical current, workshops, etc., as such will necessarily depend on the actual situation of the Institute. It would, for example, probably make for economy to maintain a small workshop for making and repair of cabinets, show-cases for museums, etc.)

(*b*) Buildings.

25. The Central Entomological Research Institute, forming the head-quarters of the Indian Entomological Service, must be situated in an accessible locality with:—

(1) an equable climate making it (*a*) habitable for the staff, and (*b*) suitable for breeding insects at all seasons of the year, and

(2) an equable and not excessive humidity in order to ensure the proper preservation of insect specimens. In a very dry atmosphere, insect specimens become so brittle as to break at the least touch, whilst an excess of humidity induces growth of mould which completely ruins all delicate specimens. In this connection it must be pointed out that proper preservation of a collection is essential, not merely on account of the money value of a collection as such, but because the actual individual specimens themselves often form an exact record (as in the case of crop-pests or in the case of types of various categories in systematic work) which cannot be duplicated if the specimens perish.

None of the present main entomological stations fulfils the above conditions. Pusa, for example, is quite unsuitable climatically, as practically all insect activities cease during the cold weather (November to February) and again during the hot, dry weather of April and May, whilst in the wet season (June to October) the humidity is excessive. Dehra Dun has a more extended cold weather than at Pusa, and I think that the humidity is too high for proper preservation of collections. Calcutta is more equable but much too humid, so that the Indian Museum has found it necessary during the monsoon to close up its insect collection, which is not available for study then; the expense of providing a suitable large area of land for the Entomological Institute in Calcutta must also be considered. Much the same remarks apply to any coast town.

Coimbatore would seem to fulfil the necessary conditions better than any other place that I know of. It is sufficiently accessible. The temperature, whilst rather high, is fairly equable, and it is possible to carry on breeding work throughout the year, whilst the adjacent hills would provide accessible localities for small laboratories for the study of insects requiring a cooler climate. The humidity is low, but excessive dryness is prevented by the proximity of hills and of the sea, and practical experience during the last ten years has shown that it is possible to keep insect collections in good order there with very little risk of mould. Coimbatore has the further unique advantage of possessing already at once an Agricultural College and a Forest College, so that the Entomological Service would be able to (1) keep in close touch with the requirements of these two services, (2) have available for consultation the views of Agricultural and Forest Officers on technical questions; and (3) utilise their libraries on these subjects, thus reducing expense in the case of numerous publications only required for very occasional reference.

Coimbatore is not ideal altogether, but it approaches the ideal locality for a Central Entomological Research Institute more closely than any other locality which I know of in the Indian Empire, and therefore, pending the suggestion of any more suitable place, I recommend Coimbatore.

As noted, there are already Agricultural and Forest Colleges at Coimbatore. Both are situated in close proximity to one another, about 3 miles west of the town. It would probably be possible to secure an appropriate site for the Entomological Institute somewhere near (probably to the north of) these two Colleges. An estate of about 150 acres would probably be required to allow of the proper disposition of the Institute, accommodation for the staff, insectaries, outbuildings, experimental areas, etc. By placing the Institute here, there would also be a saving in provision of post-office, dispensary and medical staff, electric supply, water supply, etc., as a scheme for any of these could be made to serve the Entomological Institute as well as the two present Colleges.

The Institute itself would require to be a large building, well-lighted, with large rooms for collections, records, library, etc. It seems unnecessary to draw out detailed plans at present, but the cost of building may be estimated at Rs. 6,00,000. This estimate provides for a suitable building and is not intended to include architectural fancy work.

In addition there would also be required the provision of house accommodation for the staff. This may be estimated at Rs. 6,00,000, of which only about half would be required to start with, the other half being utilised as necessitated by expansion of staff, for it would probably take ten years to get together a body of twenty really suitable men as entomological experts and the staff of men in Class II could only be increased *pari passu* with those in Class I.

In addition to the Institute, it would be necessary to provide insectaries and other out-buildings and for the fitting up of the Institute. These items, together with the purchase of the necessary land, initial laying out of roads, planting of trees, etc., may be estimated at Rs. 2,00,000.

Cost of scheme.

26. The following is a rough estimate of the foregoing scheme :—

Non-recurring charges.

	Rs.
Entomological Institute (main building)	6,00,000
Accommodation for staff	6,00,000
Purchase of land, fitting and out-buildings . . .	2,00,000
Removal of present staff, collections and records from Pusa, Dehra Dun, Calcutta, etc., to Coimbatore	10,000
	14,10,000

Recurring charges (pay).

	Rs.
Pay of Entomological Experts (20 men at Rs. 12,000 each)	2,40,000
Allowance (beyond ordinary Expert pay) to Director (Rs. 500 per mensem)	6,000
Pay of Entomological Assistants :— 20 men at Rs. 2,500 2 „ „ 3,000 each 1 man „ 4,000	60,000
Pay of setters and collectors :— 20 at Rs. 600 each 4 „ 900	15,600
Pay of clerical establishment	11,300
Pay of artists	10,000
Pay of menial establishment	4,000
Total	3,46,900

Recurring charges (allowances and upkeep).

	Rs.
Travelling allowance for Experts	30,000
Do. do. for staff	10,000
Camp charges (hire of temporary laboratories, transport of apparatus and specimens, etc.)	5,000
Laboratory apparatus	20,000
Insecticides and experimental apparatus	10,000
Books	5,000
Postage	2,000
Furniture	1,000
Miscellaneous	5,000
Publications	5,000
Estate charges	2,000
Total	95,000
Total recurring average annual charges	4,41,900

The cost would therefore be roughly fourteen lakhs non-recurring and four and a half lakhs recurring when the scheme was in full working order.

But from the above figures must of course be deducted the value of (1) accommodation to be given up, and (2) pay and expenses of the present entomological staffs. The value of the laboratory and house accommodation of the entomological staff at Pusa alone, for example, based on original cost of buildings, must be at least three lakhs, and this would be rendered available for much-needed expansion of other sections at Pusa without extra charge to Government, whilst the Pusa budget would similarly be reduced by over half a lakh; this reduction is on present rates, whereas the estimate for the proposed Entomological Service is for a full service which would take at least ten years to work up to.

Relations of the Entomological Service with other Government departments and with the general public in India.

27. Having considered briefly the constitution of the proposed Entomological Service, I will now endeavour to indicate the directions in which such a service would work in with other services and the general public in India. In

the first place, however, it should be noted that I am strongly of opinion that the Entomological Service should be a separate service, distinct from any now in existence. The subject of entomology is so vast and its boundaries in most directions are so clearly defined, that I consider that it should be treated as a separate entity and not tacked on as a minor appanage of the Agricultural Forest or similar department, or the Zoological Survey or any Phyto-pathological Institute.

Relations with Agricultural Department.

28. As the Agricultural Department in India has by far the largest and best organised Entomological Section at present, I will deal with the Agricultural Department first.

The Agricultural Department (exclusive of the Veterinary Department, to be considered later) is of course chiefly interested in (1) crop-pests, and (2) useful insects (silk worms, bees, lac). The word "crop-pest" indicates, roughly speaking, an insect which does appreciable damage to any cultivated plant; from a strictly entomological view-point, however, any exact definition becomes impossible, whilst the study of any crop-pest must include a study of its enemies and its relatives, and may thus cover a very wide field. The Agricultural officer (farmer), however, is concerned little with the entomological side, but mainly with control; what he wants is a knowledge of the best means of preventing and checking damage to his crop, and it will be the business of the Entomological Service to give the required help in this direction.

Particular problems concerning specific crop-pests will be taken up by the Entomological Service in consultation with the Agricultural Departments, and one or more Entomological Experts (with any necessary staff of assistants, setters, artists) placed on special duty to work on each. The preliminary step in such investigations will be purely entomological and will comprise a thorough study of the insect concerned in all aspects, and usually in more than one area of its occurrence. In the case of crop-pests this work can usually be done at one of the numerous stations belonging to the Agricultural Department, and temporary accommodation for the entomological staff can doubtless be arranged for in most cases by the Agricultural Department. A thorough working knowledge of the insect having been attained, the Entomological Expert will then be in a position to collaborate with the local Agricultural officer in control measures, at first on an experimental, and later on a field scale, and, a satisfactory control method once having been worked out, this can then be carried on in future by the Agricultural Department as a routine measure in connection with that crop, in the case of most methods of control by cultural or mechanical methods. This is, of course, what is done already by the entomological staff of the Agricultural Department, but the Expert of the Entomological Service will be in a better position to deal with each problem because he will have the whole help of the Entomological Institute behind him, instead of being compelled to waste time in doing every detail for himself, as under the present conditions; if, for example, in working at the crop-pest under investigation, he finds that it is controlled by an efficient parasite, he will be able to send specimens of that parasite to the Entomological Institute where it will be examined by the section dealing with that group, and the expert in the field can then be informed promptly what the parasite is and from what other pests or areas it is known and any other details available in the centralised records of the Institute. This is a very great advantage over the present system, where every entomological worker has to gather his information for himself as best he can, with the result that years of work may be wasted in control of a pest, and each separate worker (whether in different provincial Agricultural Departments or in other spheres of work) has often a few scrappy facts which are useless in themselves, but which, if co-ordinated into one whole at a

Central Institute, would often throw a flood of light on to obscure problems. In the case of effective parasites also, the Central Institute could be of great use to the Field Expert, either by rearing them in quantity at the Central Institute and sending them out as required to control crop-pests, or by sending out extra help to breed them on the spot. This has already been done to some extent from Pusa, in the case of parasites of the cotton bollworm in the Punjab, but it will only become a practicable proposition on a large scale if there is a sufficiently large entomological staff to carry out such work.

The Entomological Service would therefore help the Agricultural Service by a thorough investigation of crop-pests and by recommendations for dealing with such on a field scale, leaving to the Agricultural Service the carrying out of such control measures as a regular routine, once their efficiency had been thoroughly demonstrated. To use an Entomological Expert for routine work of this sort seems to me a waste, as his services will be much better employed in investigation of another problem requiring them.

In some cases the Agricultural Departments may require the permanent services of entomological workers to carry out routine measures, in the case of sporadic outbreaks of pests, for demonstration of approved means of control, or for other similar purposes. One very useful function would be the prompt reporting to the Entomological Institute of all outbreaks of crop-pests. In such cases the services of a highly trained expert would not be required, and the present grade of Entomological Assistants in the Agricultural Departments should be competent to do such work. They will, in fact, require to be retained and their numbers expanded as the Agricultural Departments develope, and I should be inclined to recommend that one Entomological Assistant should be placed under each Deputy Director of Agriculture for the work noted above. These Entomological Assistants* should belong to the Agricultural Departments, as at present, and work under the orders of, and correspond with, the Entomological Institute through the Deputy Directors of Agriculture. At the same time, they will be able to obtain help and advice as required from the Entomological Research Institute and will have the whole advantages of centralised collections, records and publications on entomology. It would probably be practicable, and undoubtedly it would be advantageous, to send these Agricultural Entomological Assistants to the Entomological Institute occasionally, for a short course in agricultural entomology, to rub up their knowledge.

The Agricultural Departments have also at each of their Agricultural Colleges an Entomological Assistant who gives a course in Agricultural Entomology to the College students. These men should similarly be retained in their present positions in the cadre of the Agricultural Service. At the same time they would have the advantage of the help and advice, when required, (through the Agricultural Department officers) and publications of the Entomological Institute. The course of training in agricultural entomology at the Agricultural Colleges is necessarily elementary, and the present grade of Entomological Assistants should be quite competent to give it. To employ an Entomological Expert on elementary work of this nature is a waste of his time, which could be better employed at research work. At the same time, if there was any desire to this effect on the part of the Agricultural Colleges concerned, it would be practicable to arrange to send an entomological lecturer from the Entomological Institute to give a short course of lectures annually at each college and, if necessary, to inspect the entomological courses at the colleges and keep them up to the mark. There are now Agricultural Colleges at Coimbatore, Poona, Nagpur, Sabour, Cawnpore and Lyallpur, besides Pusa, and there will presumably be Agricultural Colleges in the future at Dacca, Mandalay and Peshawar, so that a course of lectures at each of these places would make a year's work for one man. This work could be done by a senior Entomological Assistant, and it need hardly be added that such a type of lecture-course would ensure efficiency (by using the services of a specially picked man equipped with the latest facts) and economy in the preparation of specimens, models, diagrams, lantern slides, etc. Such a course of lectures would be supplementary to the ordinary College course.

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* NOTE.—For the sake of convenience I have retained the present title of Entomological Assistant, but these men could equally well be included in the ordinary cadre of the agricultural branch of the Agricultural Service (under the name of Inspectors or any suitable title).

The changes in the present entomological staff of the Agricultural Departments consequent on the foundation of an Entomological Service would be as under :—

Pusa.

The Entomological and Pathological Sections would be transferred *en bloc* to the Entomological Research Institute, only one entomological lecturer being retained at Pusa to give a course in agricultural entomology to the Agricultural students.

Madras.

The whole of the Entomological Section (with the exception of one Assistant as entomological lecturer at the Agricultural Colleges) to be transferred to the Entomological Research Institute.

One Agricultural Entomological Assistant to be provided to work under each Deputy Director of Agriculture.

Bombay, Central Provinces, Bihar, Bengal, Assam, Burma, United Provinces and North-West Frontier Province.

No change except that one Entomological Assistant to be provided to work under each Deputy Director of Agriculture.

Punjab.

The recently sanctioned post of Entomologist to be absorbed in the staff of the Entomological Institute. No other change except that one Entomological Assistant to be provided to work under each Deputy Director of Agriculture.

At present, therefore, there would be comparatively little change in most of the provinces but, allowing for future expansion of the Agricultural Departments in the provinces into suitable circles, each under an Agricultural officer and each provided with an Entomological Assistant, the numbers required would be approximately as under* :—

Province.	For fieldwork in Agricultural circles.	For teaching at Agricultural Colleges.
Baluchistan	1	...
North-West Frontier Province	3	1
Punjab	5	1
United Provinces	5	1

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* NOTE.—I have made no provision for Mesopotamia as it is at present uncertain how much will be included in the Indian Empire.

Province.	For fieldwork in Agricultural circles.	For teaching at Agricultural Colleges.
Bihar	5	1
Bengal	5	1
Assam	4	...
Burma	6	1
Madras (including Coorg)	7	1
Bombay	6	1
Central Provinces and Berar	5	1
Pusa	...	1
TOTAL	52	10

The cost of the foregoing alterations would show a saving to the Agricultural Department on the present figures, but would increase gradually as the country becomes subdivided into circles until the full numbers were attained. On a basis of full numbers, the cost for each Agricultural Entomological Assistant would be roughly :—

	Rs.	Rs.
Pay	2,500	5,000
Travelling allowance	1,500	
Apparatus, insecticides, and general office charges	1,000	

In some provinces the rates of pay are lower than in others, but probably a figure of Rs. 5,000 per annum represents a fair average for India as a whole. In the case of the College lecturers there would be a saving on travelling allowance and insecticides, but, on the other hand, these posts would be generally held by the more senior and experienced and intelligent men whose pay would run higher, so that in their case also the annual budget estimate of Rs. 5,000 may be taken as a fair average.

On these figures the cost would approximately be :—

	Rs.
Baluchistan	5,000
North-West Frontier Province. Four new men at Rs. 5,000 =20,000, less approximately Rs. 1,000 now spent	19,000
Punjab. Six men at Rs. 5,000=Rs. 30,000, less approximately Rs. 25,000 for Government Entomologist (already sanctioned), staff, and office expenses	5,000
United Provinces. Six men at Rs. 5,000=Rs. 30,000, less approximately Rs. 2,000 now spent	28,000
Bihar. Six men at Rs. 5,000=Rs. 30,000, less approximately Rs. 7,000 now spent	23,000
Bengal. Six men at Rs. 5,000=Rs. 30,000, less approximately Rs. 1,000 now spent	29,000
Assam. Four men at Rs. 5,000=Rs. 20,000, less approximately Rs. 2,000 now spent	18,000
Burma. Seven men at Rs. 5,000=Rs. 35,000, less approximately Rs. 5,000 now spent	30,000
Madras. Eight men at Rs. 5,000=Rs. 40,000, less approximately Rs. 20,000 now spent	20,000
Bombay. Seven men at Rs. 5,000=Rs. 35,000, less approximately Rs. 6,000 now spent	29,000

	Rs.
Central Provinces and Berar. Six men at Rs. 5,000 = Rs. 30,000, less approximately Rs. 4,000 now spent .	26,000
	+2,32,000
Pusa. (As post-graduate teaching will be given here the man selected will require higher pay.) One Lecturer + Rs. 8,000, less present cost of two Entomological Sections—Rs. 75,000	—67,000
	+1,65,000

But it should be remembered that, in the absence of a centralised Entomological Service, the entomological staff of the Agricultural Department in nearly all the provinces would normally expand to include at least one Entomologist and a staff, besides expenses for laboratories, house-accommodation, library, etc., so that the totals for all major provinces (except Madras and Punjab) require a relative reduction of roughly Rs. 20,000 each.

Relations with Forest Department.

29. The relations of the Entomological Service with the Forest Department would roughly follow those of the Entomological Service with the Agricultural Department.

There would be firstly the Entomological Experts, with their assistants and collectors, employed on investigation of forest pests. This work would necessarily be done in close touch with the local Forest officers, who would carry out control methods for each pest after these had been worked out. The Experts' work would be primarily research on the insects concerned, their life-histories and occurrence, followed by experimental work on control in close collaboration with the Forest officers, at first on a small scale and later (if successful on a small scale) on a larger scale, measures found successful on a large scale being thereafter carried out by the Forest officers as routine methods in checking particular pests. It should be noted that such measures would usually become purely silvicultural operations.

The Forest Department would probably also require on its own staff the services of a small number of subordinates (1) to collect information regarding the occurrence of insect pests, and (2) to apply approved control measures under the Forest officers. I have no exact information regarding the number of forest areas in which such men could be usefully employed, but, if there were twenty such men in the department, this would allow roughly for one such man under each Forest Conservator. Their duties would be to tour in such areas as were indicated by the Conservator under whose orders they were acting, and to enquire into and collect specimens of all insects found damaging forest trees, such specimens and information being forwarded through the Forest Department to the Entomological Institute, which would then possess an exact record of the occurrence of forest pests in each area. These records would, in the course of time, prove an invaluable asset in allocating the investigations to be undertaken by the Entomological Experts, both on the part of the Forest Department and of the Entomological Service. The amount of pay, expenses and travelling allowance for each of these men would undoubtedly vary considerably in different districts, but probably a sum of Rs. 5,000 for each annually would cover all expenses on a general average for the Indian Empire.

The Forest Department would also require to provide for instruction in forest entomology at their Research Institutes at Dehra Dun, Coimbatore, and hereafter in Burma. Very advanced instruction is not required, but the instructor should be attached to the Forest Research Institute permanently in order that he may be able to accompany the Forest students on instructional tours. Such a post of instructor could probably be filled in course of time by selection from the Forest Entomological Assistants described above, and would form a higher appointment for the best of such men, being graded roughly on a scale of pay of about Rs. 250-600. It should be practicable to get together the Forest Entomological Assistants and Forest Entomological Instructors at regular intervals (annually or biennially), either at the Entomological Institute or at the Forest Research Institutes, to discuss their work and to go over it with the Entomological Experts employed on forest work, so as to get the fullest benefit out of the work of these men.

The following is the estimated cost of the scheme :—

	Rs.
Twenty Forest Entomological Assistants* at Rs. 5,000 each .	1,00,000
Three Entomological Instructors (one each for Dehra Dun, Coimbatore and Burma) on pay of Rs. 5,000 with travelling and other expenses of Rs. 3,000. 3 (Rs. 5,000+3,000) .	24,000
Total .	1,24,000
Deduct cost of three Forest Zoologists (one each for Dehra Dun, Coimbatore and Burma) with pay, allowances, and staff transferred to Entomological Service. Say Rs. 25,000 each .	—75,000
Total .	+49,000

The total extra cost to the Forest Department would, therefore, come to roughly half a lakh annually, which is a comparatively small sum to pay for a comprehensive system of investigation of forest pests throughout the Indian Empire, whilst half of this sum represents cost of instruction of Forest students.

Relations with the Medical Department.

30. This subject has already been dealt with to some extent under "Problems in Medical Work." I think that the whole work, from the entomological side, could be carried out by the staff of the Entomological Institute, and that it would not be necessary for the Medical Department to maintain any special entomological staff of its own.

Estimated cost of the scheme would be :—

	Rs.
Medical Entomologist, staff and allowances, at present paid from Medical Research Fund—to be transferred to the Entomological Institute	10,000 (approximately).

Relations with Veterinary Department.

31. It is proposed to employ one Entomological Expert, with necessary staff, exclusively on investigations of insects carrying disease to domesticated animals in the Indian Empire. His work would be arranged by the Director of the Entomological Institute in consultation with the Imperial Bacteriologist and the principal Veterinary officers in each province. The Expert would tour as required and work at his problems in close collaboration with the local Veterinary officers. The Veterinary Department would also have the benefit of the use of the Entomological Institute for identification of insects found in association with domestic animals.

The scheme would imply no increased or decreased cost so far as the Veterinary Department is concerned.

Relations with the Indian Museum.

32. In the term "Indian Museum" I propose to include the Zoological Survey because, although nominally separate, the work of the Zoological Survey is centred in the Indian Museum at Calcutta.

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* The title is immaterial. They could be called Entomological Rangers or any other title.

The present staff of the Indian Museum, so far as entomology is concerned, comprises one Assistant Superintendent and a small number of assistants and setters (about two assistants and three setters). The collections, as in most large museums, comprise (*a*) a small collection, open to the public, of representative examples of insects, and (*b*) a larger collection, or series of collections, not open to the public but only intended for special entomological students. The collections contain some good material, but are comparatively small, nor does there seem to be much room in the Museum building for sufficient expansion to provide for a really representative collection of Indian insects. If any serious attempt is to be made in the future to provide for a large collection of Indian insects, the Museum (including Zoological Survey) would have to provide at least a dozen specialist workers to work on nothing but the systematic side of entomology, and even a dozen men could not attempt to tackle the whole insect fauna of India, whilst, if they did, their work would (1) necessarily overlap that done by other entomological workers (under present conditions) in the Agricultural, Forest, and other Government departments, (2) be comparatively worthless to the Indian Empire, if nomenclature as such were to be the final aim of these Museum workers. The climate of Calcutta, also, is absolutely unfitted for the proper preservation of dried insect specimens, owing to the excessive damp during the rains.

I do not think that the Zoological Survey will ever be in a position to correlate the varied entomological work even now being done in India, largely because the area of entomology is too vast for inclusion in the Survey, without an unduly large expansion of its staff. It must be remembered that about 80 per cent. of the whole Indian fauna is composed of insects.

I recommend that the whole of the Entomological Section of the Indian Museum (including staff and study collections and library, so far as these are the property of Government,) be transferred to the Entomological Institute, leaving the Indian Museum a small collection of insects for exhibition to the public, this small collection (and other similar collections in other museums) to be maintained in future by the Entomological Service, which would depute a special Assistant to go around the various museums to see to the renewal, display and upkeep of such public collections. By this means the Zoological Survey would be able to specialise more completely on marine biology, in which direction the officers of the Museum have been doing good work (specially in connection with the R. I. M. S. "Investigator" and fresh-water fauna) for some time past. The Museum would also remain a centre for work on mammals, birds, reptiles, and other animals, except insects.

The cost of the scheme to the Museum would be :—

	Rs.
Cost of present Assistant Superintendent for entomology, staff and expenses, to be transferred to Entomological Institute	—12,000 (approximately).

Relations with other museums in India.

33. There are various other Government museums in India (at Madras, Nagpur, Lahore, Darjeeling, etc.), and many of these maintain a small exhibition collection of Indian or local insects. There are no regular entomological staffs at any of these museums (except the Indian Museum at Calcutta), and the exhibited series of insects are as a rule very poor. With the aid of the Entomological Institute, which would be yearly receiving large collections of insects from all parts of the Indian Empire, it would be quite practicable to put aside a proportion of identified and surplus duplicates of insect specimens for these museums, due regard being paid to local requirements, and to send around a specially selected Assistant to visit such museums periodically and arrange such duplicates for display, replace faded and damaged

specimens, and generally look after this section of each museum. By this means the museum staffs would be relieved of a piece of technical work with whose details they are not usually conversant, and the general public visiting the museums would gain by seeing the best available collection of insects. There would be no idea of setting up complete collections of insects in these museums, but only of exhibiting representative series, which is all that is required generally.

The cost of the scheme to the museums would be *nil*, and the gain in general efficiency would be considerable.

Relations with Educational Service.

34. The museums and Medical Services come under the general heading of "Education", but I refer here more particularly to the relations of the Entomological Service with the Educational Department as such.

The Entomological Research Institute would be intended purely as a Research Institute, and it is not intended that the energies of the staff should include regular training in entomology, although of course all real students would be welcomed and given every facility for work. There would thus be no direct relations or competition between the two services; but the experience and knowledge of the Entomological Service would be freely available to the Educational Service for such items as the preparation of nature-study manuals or any similar items which might deal with life-histories or bionomics of insects.

Relations with Geological Survey.

35. The Entomological Experts at the Entomological Research Institute could doubtless assist the Geological Survey by technical advice regarding fossil insects, which may at times throw some light on palæontological problems. Similarly, it is probable that in some cases the distribution of certain insects may depend on the geological nature of certain areas, and the Geological Survey could advise on this point; in this connection it may be noted that, as the Entomological Institute is intended to gather a general collection of insects from all parts of the Indian Empire, it will be in a far better position to study such problems as distribution, than any of the present scattered workers, each with an incomplete collection.

Relations with Customs.

36. The notification yet to be issued under Act II of 1914 for regulating the importation into India of insect pests must be considered in this connection. As experience is accumulated, it is inevitable that more stringent restrictions will be found necessary to regulate the importation of insect pests and to control by legislative means those which are already in the Empire, and it is obvious that a strong Central Entomological Institute will be in the best position to advise on any points which may arise and to carry out in a uniform manner any restrictions which it may be found necessary to impose. If there is one centralised Entomological Institute, the Customs Department will know exactly where to apply for any information required and, if it should be necessary (for example) to provide an entomological staff for inspection or fumigation of imports or to carry out the requirements of any Internal Pests Act, such staffs should be under the control of, or at least in touch with, the Entomological Institute.

Relations with other entomological stations and workers outside India.

37. As already pointed out, the entomological worker in India is concerned not only with problems of his own area, but with similar or cognate problems of areas outside of his own. The insect pests of Ceylon, Java, Malaya Formosa, Queensland, and to a less extent of other parts of the world, are not only of interest but of importance to the worker in India, and it is absolutely necessary to keep in close touch with work that is going on in these other localities, whilst of course our work in India is of equal interest to them. The advantages of a centralised Entomological Institute are perhaps nowhere more apparent than in dealing with this aspect of the subject. If, for example,

there are numerous scattered workers in India in the Agricultural, Forest Medical and other departments, it is equally impossible for each of them to keep in proper touch with extra-Indian work and for extra-Indian workers to keep in touch with the work of each one of them. There are also grave difficulties, such as those concerned with the languages (French, German, Latin, Dutch, Italian, Spanish, etc.), in which such extra-Indian publications are issued; no one entomological worker can be expected to be conversant with all even of the six languages named above (although he should know at least two), even if he should be able to get hold of all the various publications; but it would be a comparatively easy task to receive in one Entomological Institute all these scattered publications and to have them abstracted and, if necessary, translated for the use of the Institute. Similarly, it would be of the utmost advantage to all extra-Indian workers to have all publications on Indian insects issued and available from one centre, so that they could at once ascertain what work had been published on any particular insect, instead of having to consult numerous journals and publications of several departments, as at present.

Publications. 38. As pointed out in the preceding paragraph, the present system of publication of information on Indian insects is so diffused that it is becoming increasingly difficult to keep track of the literature. When the Entomological worker has to keep track of the information on Indian insects published in India in the *Bombay Natural History Society's Journal*, the *Indian Journal of Medical Research*, the *Agricultural Journal of India*, the *Memoirs* and *Bulletins* of the Agricultural and Forest Departments, the *Indian Forester*, the *Memoirs* and *Records* of the Indian Museum, besides innumerable provincial journals, leaflets and other publications on agriculture, etc., the work becomes more involved as the sets of these publications expand; but, when he enters on extra-Indian literature, he has to contend with an absolutely unwieldy mass of publications, past and present, many of which have to be gone over in detail to see whether they contain any information of interest or importance, as the mere titles of papers are frequently very misleading.

For the sake, therefore, of all interested in entomological publications, both in and outside of India, I recommend that all the present purely entomological publications issued by Government should be discontinued and amalgamated into one set of publications to be issued by the Entomological Research Institute.

The publications of the Entomological Research Institute would include (1) reports and results, scientific and applied, of the work of the staff of the Institute; (2) such other papers on Indian entomology as were deemed of sufficient value to merit publication; and (3) abstracts of all current literature on Indian insects or related problems.

In the case of other Government publications, such as the *Agricultural Journal of India*, they would not necessarily be deprived of all entomological contributions, although the tendency will be for such publications to become more specialised, but, if entomological papers were published in such, they would be abstracted by the Entomological Institute, and so brought to the notice of the entomological public.

Summary of foregoing. 39. In a short historical *résumé* of the rise and progress of entomology in India, I have indicated briefly the growth of this study until the present time, when it deals with roughly 35,000 different described forms of insects, this being, perhaps, roughly half of those actually existent within the Indian Empire. Subsequently I have reviewed the progress made in entomology by the Indian Museum, the Agricultural Department, the Veterinary Department, in medical entomology, in forest entomology, and in other entomological work in and outside of India, and have endeavoured to show that the scattered efforts made in these various directions show a lack of the coherence necessary to the best efficiency, which can, in my opinion, be best secured by a centralised scheme of entomological research. I have also briefly reviewed the progress of applied entomological work in the United States, Canada, South Africa, and Australia, in which cases also the results actually attained seem to support the idea of the advantages to be derived from a centralised scheme in India. Finally, I have sketched out such a centralised scheme in some detail.

SUPPLEMENTARY QUESTIONS AND ANSWERS.*

Q. 1 (*a*) Is it not the case that for agricultural entomology, the life-history of an insect must be examined and remedial measures devised, in close and constant touch with agricultural, botanical and economic conditions, in order to avoid work on impracticable lines ?

A. This is obviously the case with this qualification, that a close study of the bionomics of the insect in question must precede and form the foundation of any applied remedial measures. There is much less danger, as is shown by practical experience in the past, of any want of close touch with agricultural, botanical, or ecomonic conditions than there is of work on wrong lines owing to want of detailed work on the bionomics of the insect or insects concerned. As examples of this I would adduce the following instances which are only a few out of many :—

(1) Termites destroying wheat at Hoshangabad ; see pages 196-197 o "Report of the Second Entomological Meeting."
(2) Cane-borers ; see pages 142-143, *loc cit.*
(3) Further recent work has shown that the rice-stem borer (Chilo sp.) is distinct from borer (Chilo simplex) in *juar*, etc., with which it has hitherto been confused.
(4) Microbracon (Rhogas) spp. parasitic on cotton bollworm (Earias spp.) see page 107, *loc cit.*

In all these cases, and in numerous others, detailed work on purely entomological lines is necessary as a pre-requisite of any applied work. In such cases as control of pests by the use of natural parasites, work on purely entomological lines will be required, not only because such work requires special technique in breeding, etc., such parasites, but to ensure that only efficient parasites are utilised and that they are used under the best conditions, free from hyperparasites, etc. Work of this sort requires the very best type of entomological worker devoting his whole time and attention to one particular problem, and it is only after this preliminary and purely entomological investigation has been carried out that we shall really be in a position to begin to consider remedial measures in relation to the agricultural, botanical or economic aspects of each case. In the meantime, we can of course recommend rough and ready remedies in many cases (*e.g.*, bagging of grasshoppers, hand picking of caterpillars, spraying, etc.), but such remedies are merely temporary palliatives to minimise damage actually being done, whereas what is required is the prevention of damage. As regards collaboration with agricultural, botanical or other experts by members of the Entomological Service, this is fully provided for in my scheme (see remarks under "Relations with other Government Departments "), and I do not think that anything more requires to be said under this heading.

Q. 1 (*b*) Is not this likely to be the case with other lines of work ?

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* These answers were given in reply to questions of the Commission based on the foregoing proposals.

A. I understand this question to refer to the devising of remedial measures for other than agricultural pests and the reply to the preceding question will apply equally, *mutatis mutandis,* to this one.

Q. 2. In view of the necessity so shown of keeping in touch with provincial departments and of the strong representations for autonomous department that provincial Governments will set up, will it not be sufficient :—

(1) to have an Entomological Service, in order to facilitate recruitment and promotion,

(2) to second a large proportion of its members to provincial or other departments for definite periods or problems,

(3) to maintain touch among workers by submitting their reports to the central authority of the Entomological Department, by periodical meetings, by the publication of records, and by tours of inspection by the head of the Entomological Department who would advise Local Governments and departments ?

Would not these measures obviate the danger of overlapping or unnecessary duplication of work in the case of a pest common to more than one province ? Might men so seconded be given special allowances for different classes of work as to which the head of the Entomological Department would be consulted ?

A. The benefits to be derived from a centralised scheme, as already outlined in my note, appear to me to outweigh any representations that may be set up by provincial Governments for autonomous departments. In my opinion, the question of expansion of entomological work, in all its aspects, in the provinces cannot be considered apart from the far larger question of the development of entomological work in the Indian Empire as a whole. We have now had sufficient experience during the last twelve years :—

(*a*) to indicate the lines on which expansion of entomological work in India is necessary and desirable,

(*b*) to foresee the effects in the future of development on the present decentralised lines, and

(*c*) to reorganise the work before such decentralised development has gone too far.

I am quite aware that any scheme for centralisation of work will be likely to be looked at askance from a purely political point of view, but India is a large country and also a relatively poor country, and furthermore a country in which the ravages of insects, as pests of crops and forests and as carriers of diseases to man and animals are of vast monetary value. Yet, as Indian revenues cannot provide for more than a limited amount of control of such injurious insects, it is the more necessary to see that the very best and most efficient use is made of the amount of money available, and this necessity should take precedence of any *amour propre* desire of provincial Governments to have their own autonomous departments. I am, as a matter of fact, doubtful whether there will be the amount of opposition implied in the Commission's question on the part of Local Governments to a centralised scheme of entomological work, at least as far as the Agricultural Departments are concerned. I have discussed my scheme informally with several Directors of Agriculture and other officers of the Agricultural Departments, and their opinion hitherto has been that such a scheme will meet the requirements of the provincial departments. Some weight might, perhaps, be attached in this connection to the feeling of agricultural officers (*i. e.*, agriculturists as opposed to specialists in other branches) that they themselves have not the special knowledge requisite for the control of such specialists' work (particularly in the future as this becomes more and more detailed and specialised), and they are therefore likely rather to welcome than to oppose the transfer of the control of such specialists' work, provided that their own departments do not suffer. Furthermore, in the case of practically all our Indian insect pests, the preliminary entomological investigation will be applicable, not to one province also, but to all areas in which such pests occur, although it is possible in some cases that control methods will vary in accordance with varying agricultural practices, although any variation in these last does not necessarily coincide with provincial boundaries. So far, then, as concerns the research side of the work, which will be the main object of the Entomological Service, this will not be provincial in its aspects. I am very strongly of opinion that efficiency and economy can only be combined, so far as entomology in India is concerned, by a centralised scheme of research and work, at least somewhat on the lines I have endeavoured to describe in my note. It is, I think, our duty now to initiate a comprehensive policy, considered from the point of view of the Indian Empire as a whole and not from any provincial outlook, and which will be capable of expansion without overlapping of different branches of work or scrapping of previous work, and which will be of immediate benefit to the peoples of India in the present generation and of incalculable benefit to their successors.

As regards the seconding of a large proportion of the members of the Entomological Service to provincial or other departments for definite periods or problems, this is dealt with in the sections of my note under "Problems in agricultural work" and following paragraphs, read in conjunction with "Relations with other Government departments". I see no necessity for seconding the members of the Entomological Service to other departments, as such a procedure would cut at the very root of the whole idea of the Entomological Service as such, *viz.*, that the investigators working on particular problems should be unfettered by any local restrictions or other demands on their time. As already pointed out, the distribution of any pest will very rarely coincide with provincial boundaries, and its investigator must be free to work on it throughout its whole area of occurrence. Nor should his time be taken up with unnecessary correspondence, teaching, or the investigation of Local problems outside his specific objects of study; if seconded to a Local Government or other department, there would be sure to arise cases where dual sets of instructions to the investigator would lead to loss of efficiency in work. I am, therefore, against any idea of seconding. The investigators should be treated as touring officers from the Central Institute, although the tour in some cases might be a prolonged one. They would in fact be detailed for definite problems, but not for definite periods. If the entomological experts were to be seconded for definite (and presumably prolonged) periods, the Local Governments or departments would have to provide proper accommodation, laboratories, libraries, etc., which expenses are avoided by my scheme.

Proposals for maintaining touch between the Entomological Service and other workers under the provincial Governments or in other departments by periodical meetings, by publication of records and by touring have already been included in my note. The members of the Entomological Service out on tour would keep in close touch with the Entomological Institute by frequent correspondence (including reports) and by visits to headquarters as necessary; at the present stage it is unnecessary to elaborate rules for this.

As regards the prevention of overlapping of work by mere advice to Local Governments and departments, past experience has clearly shown that such a system is a failure in many cases because, if the technical experts are only empowered to advise without any control, in practice they cannot advise in cases where little or no interest is taken in the work or where the work is being done on wrong lines by local officers. In such cases, advice is only given when it is asked for and, if given unasked, is not followed, with the result that it is not volunteered subsequently. If there is no control, there is no responsibility, and, without a sense of responsibility, there ensues a decided lack of interest, which results in a loss of efficiency in the work.

As regards the giving of special allowances to men employed on different classes of work, I think it is premature to lay down any rules regarding such cases. As noted in my scheme, "the pay would depend largely on the special qualifications of each man", and his qualifications and capacity would necessarily determine his line of work. If the men employed away from the Entomological Institute were regarded as on tour, they would presumably receive travelling allowances under the ordinary regulations to compensate for the extra expenses to which they would be put, and in some cases it might be necessary to give special extra allowances in special cases. For example, if the Pathological Expert were to give a course in medical entomology at one of the Tropical Medicine Institutes in Calcutta, Bombay or Madras, he might be given a special allowance whilst doing so, to compensate for the extra expense of a prolonged halt in an expensive locality. But, as already stated, I think it is premature to consider such cases, which could be dealt with as they arose.

APPENDIX L.

INDUSTRIAL DEVELOPMENT AND PUBLIC HEALTH.

By Major F. Norman White, C.I.E., M.D., I.M.S.,

Sanitary Commissioner with the Government of India.

Fundamental importance of 'public health' in industrial development.

In spite of the remarkable advance ever being made in the perfecting of labour-saving devices, the human being remains the most important machine in the production of wealth and in industrial development. Viewed thus, all measures designed to improve the efficiency of the human machine are matters of economic importance that modern industry cannot afford to overlook. It is ever becoming more clearly recognised that 'Public Health,' with its two main functions of preventing disease and increasing the welfare of the individual, is of fundamental importance in the industrial development of any country; that the question of man power is fundamentally a health question; and that health considerations must enter very largely into the relationship of capital and labour as well as into all other sociological problems of the present day. Such assertions are true of every country; but in India, where labour is less organised than in the more advanced countries of the west, where the prevalence of parasitic infections and serious epidemic disease is excessive, and where climatic conditions and environment generally are extremely unfavourable, the neglect of public health brings an immediate and striking punishment. In spite of this, the subject of industrial hygiene has received remarkably little attention in India until quite recent times, and to-day its importance is not fully recognised in any part of the country. The main cause of this neglect of so important a matter would appear to be due to the fact that labour in India has been in the past both plentiful and cheap; moreover, the introduction of public health reform in India has ever been attended with peculiar difficulties, difficulties which dictated a policy of *laissez-faire*, incompatible with progress.

Even in England, where health matters were in a relatively advanced state, special laws to safeguard the well-being of munition workers were considered necessary to secure a satisfactory output. It was realised that all new industries present special health problems which demand attention. How much more do such matters require attention in backward India?

Neglected health conditions in labour-recruiting centres and necessity for reform.

2. The recruiting centres of Indian labour forces are for the greater part rural areas, where public health conditions are no whit more advanced than they were when the etiology of all the important communicable diseases of the tropics was enshrouded in mystery. It has been possible to apply a few of the remarkable results of modern research to urban areas, but there are no considerable rural tracts in India that have benefited, for example, by the discovery of the part played by mosquitoes in the propagation of malaria. And yet, more than 90 per cent. of the population of India is a rural one and malaria is all but everywhere prevalent, playing a part of overwhelming importance in the morbidity of the country. This is not the place for a full discussion of all the causes underlying the neglect of public health in rural India; reference to the matter has been dictated by a desire to indicate the extent of the ground lost and the consequent necessity for making an immediate start, if India is to compete with any prospect of success in modern industrial enterprise.

In the complete absence of any rural health organisation, it is not possible to cope with outbreaks of plague and other devastating diseases which are of annual occurrence, and which run their course almost uncontrolled. Such epidemics can and do interfere most seriously with recruitment of labour, quite apart from the so serious direct mortality they inflict. Moreover, labour recruited from such unhygienic surroundings is seriously handicapped from the first. Living an outdoor life, engaged in agricultural pursuits, the ryot is able to put up with the considerable degree of parasitic infestation so commonly seen; malaria and hook-worm infection, for example, is not incompatible with a fair output of agricultural work in such circumstances. Transference to large industrial centres, however, involves a change of environment which apart from other considerations connotes increased liability to disease. A more confined atmosphere, crowded insanitary dwellings, lack of outdoor recreation are certain to exercise a baneful influence and render the factory employé more liable to fresh infections and to upset the compromise that his body has been able to effect with the parasites that it harbours. Had the large employer of labour a plentiful supply of really healthy material to start with, he would still be under an obligation to secure for his operatives an environment above reproach; how much greater is the present need for hygienic environment, when in most cases cure has to precede the conservation of health?

From what has been said it will be clear that the progress of health administration in India as a whole and the control and eradication of communicable disease are matters of vast economic concern to the industries of India. The writer is firmly convinced that an improvement in general health conditions is a necessary preliminary to industrial as well as to all other forms of development.

It is frequently stated and commonly accepted that a community or a country can obtain as much health as it is willing to purchase, but it is not so commonly realised that large sums devoted to the purchase of health are certain to be remunerative financially. In this country it is generally assumed that early progress is impossible, and that education must precede any real progress in health matters. If all teachers in our primary schools had even a small acquaintance with the laws of health, and lived as if they believed in them; if they were never unmindful that children take their bodies to school, as well as their minds, something might be said in favour of the policy of making sanitation wait on education; progress though slow would be sure. As things are, the waste of educating children and then allowing them to die of preventible disease before they attain the age of productivity is sufficient to demonstrate the economic necessity at least of allowing the two activities to proceed *pari passu.* Moreover, a mind enclosed in a healthy body is infinitely more receptive than one enclosed in the parasite-infested body that is found so commonly in our schools. Sir Ronald Ross states in his book "The Prevention of Malaria":—'I have seen a large class of coloured children, almost all of whom were suffering at the time from fever or enlargement of the spleen, being taught the dates of accession of the Plantagenet kings.' If health development has to wait on education of such a kind, progress is impossible.

Inefficiency of Indian labour largely a health problem.

3. All are agreed that the organised labour of India is relatively inefficient, and that the wage-earning capacity is low. It is difficult to assess the importance of disease as a contributory cause of this state of affairs. There is very little statistical data that can be relied on regarding the incidence of occupational disease or of the effects of industrial occupation on the prevalence of the common forms of communicable disease. This is a matter that urgently calls for thorough investigation. The difficulties of such an investigation are

considerable, not the least being due to the fact that industries are not supplied by a settled labour force. When disease makes further labour impossible, the unfortunate victim commonly departs to his village and is lost to observation.

In spite of the admitted paucity of reliable statistical data, it may be profitable to offer a few remarks as to the effects of three diseases on the efficiency of labour, *viz.*, malaria, hook-worm disease and tuberculosis. These three diseases have been selected for the following reasons. Malaria and hook-worm infection are almost certainly the two most potent causes of "inefficiency." Both are almost universally prevalent in India; both exercise their malign influence from earliest childhood and seriously interfere with bodily and mental growth and development; both, by undermining the constitution, render the body more prone to infection with other disease. Directly and indirectly they are responsible for an enormous mortality bill. Tuberculosis has been included because of the special risks, with regard to spread of infection, entailed by large aggregations of labour in any but the best hygienic surroundings. In India a low degree of prevalence of these three diseases indicates a satisfactory environment and a high level of personal hygiene. The three diseases together can in fact be used as a reliable gauge of the sanitary and health conditions of any Indian community.

Hook-worm disease and industrial efficiency.

4. The increased attention that has been devoted in recent years to the subject of hook-worm disease is largely the result of the initiative displayed by the International Health Commission of the Rockefeller Institute. For years past we have known hook-worm infection to be very common in most parts of India, but because ankylostomiasis, or serious symptoms *directly* attributable to the parasite, is comparatively rare, we in India fell into the rather natural error of assuming that the hook-worm is not a factor of any great moment in the morbidity of the country. Having realised this assumption to be unjustifiable, the matter has been made the subject of fresh investigation, with the result that in large areas of the country infection with this noxious parasite is found to be almost universal. In the Madras Presidency little short of 100 per cent. of the rural population are infected. Over 70 per cent. of the tea-garden labour forces of Darjeeling are infected, and a similar state of affairs is found to prevail in the plains of Bengal. Enquiries are being prosecuted elsewhere. In India most of the infections are light, *i.e.*, the number of hookworms per case is not large. A casual inspection of the inhabitants of a village, all of whom harbour the worm, always raises the doubt as to the possibility of the worm being a potent source of harm. Apparent good health and the presence of, say, fifty hook-worms in the intestine are certainly not incompatible. 'Good health,' however, is but a relative term, and we have already had sufficient experience to learn that the phrase connotes a much higher standard of efficiency among a population that has been freed from hook-worms than among an infected one. There are instances in the gardens of Ceylon of the output of the Indian labouring forces having been increased as much as 25 per cent. as the result of treatment with vermifuges, and this surprising increase in efficiency has been accomplished with a lessened prevalence of disease of all kinds. A marked increase in efficiency has been noted, similarly, in the Darjeeling tea gardens, after general medication with thymol. In short, there is ample justification for the dogmatic assertion that eradication of hook-worm infection from Indian industrial forces is certain to be followed by an appreciable increase in general efficiency, consequent upon improved general health and the lessened incidence of other diseases, chiefly those of an intestinal nature.

It is not, however, the direct results of hook-worm campaigns that are alone important. The collateral benefits that well-organised campaigns have secured have been even more striking than the direct results achieved. Most have led to a demand for sanitary reform, that has led to a further lessened prevalence of almost all diseases. Experience in the southern states of America is a striking illustration of this. The oft-quoted American experience in the Bilibid jail in Manilla is another case in point. When America assumed charge, the death rate in that jail was reported to be 234 per mille. The introduction of all the ordinary sanitary improvements effected a rapid reduction to 75 per mille. Further improvement was not effected until the question of hook-worm was investigated; the administration of thymol was followed by a reduction of the mortality rate to 13·5. The recent marked improvement in the health conditions of Assam jails is almost certainly another case in point.

Instances could be multiplied, but enough has been said to emphasise the importance of the matter to all large employers of labour in India. A thorough hook-worm campaign offers perhaps the best opportunity of effecting a rapid improvement in the health conditions and consequently the efficiency of our labour forces.

Malaria and industry.

5. The still larger question of malaria can only be dealt with very briefly in this place. As has been indicated, the general incidence of this disease throughout the country is a matter of grave moment to all connected with industrial enterprise. The problem can only be approached when the country has realised the urgent need of a real health organisation in every district throughout the country. The incidence of the disease can be markedly diminished if we are prepared to pay the bill. Once we have embarked on the enterprise, there is little fear that the money will not be forthcoming; results will be patent and the value of health as an imperial asset will be recognised.

One aspect of the malaria problem calls for notice. Indian experience is full of examples of the serious, almost paralysing, effects of outbreaks of malaria among large labour forces engaged on the construction of canals, railways, docks and such like. It is doubtful, however, whether we have yet learnt the lessons taught by past experience. Such outbreaks are in almost every case preventible. Whenever such enterprises are undertaken, the special health problems that are likely to arise call for most careful consideration; the dangers can nearly always be anticipated. When a military force, however small, takes the field, the necessity of a sanitary organisation and precautions to safeguard the health are never overlooked. It is realised that their neglect is certain to lead to disaster. Quite as elaborate precautions are called for in many of our large constructional works, but, with few exceptions, the measures taken in the past have been most inadequate, or altogether wanting, a neglect that has involved both waste and sometimes disaster. Large projects of the nature alluded to are rarely referred to a health expert at any stage of their inception; their probable "financial" cost is estimated to a rupee; their probable cost in human life receives no consideration whatsoever. The Panama Canal was a triumph for the engineer; it was a still greater triumph for preventive medicine which made the engineer's work possible; for once the health official was not subordinated, but given plenary powers; and he made good. Is it not an irony that the most important research of which the results were applied with such profit in Panama was research work done in India, work which has done so little for India as yet?

Tuberculosis is an industrial disease.

6. As regards tuberculosis and its special prevalence in workshop and factory, we have very few statistical records to guide us. There is evidence, however, that the disease is more prevalent in the large industrial centres than elsewhere; that the disease is definitely on the increase in rural areas abutting

on such centres, from which labour is drawn and to which the victims of the disease go to die; and that sufficient precautions are taken in few factories, to reduce the risk of such places affording facilities for the transmission of tuberculous infection from the sick to the healthy. The city factory and the crowded workshop are not the natural habitat of human beings, and every precaution must be taken to prevent the unnatural environment acting deleteriously on the employés.

Hygiene of factories.

7. This brings one to a consideration of the health conditions of the Indian factory and workshop and of the arrangements made for the housing of employés. The Indian Factories Act, 1911, is fairly comprehensive. There is however insufficient recorded evidence to justify the formation of an opinion as to how it works in practice from the point of view of preventive medicine. Nor do I know how many, if any, health experts have been appointed inspectors under the Act. This is a matter which it might be profitable to consider. The prohibition of the employment of persons suffering from communicable disease does not appear to have been considered in the framing of the Act; this matter also seems worth consideration. The provision of receptacles into which the employés could expectorate with safety is a small but important point, taking into count the habits of the Indian. Such matters cannot be supervised without efficient health inspection; it is for this reason that reference has been made to them.

Housing of operatives: overcrowding of industrial centres, etc.

8. The housing of operatives is a matter that is fraught with much difficulty. From the public health standpoint, it is most desirable that industrial development be attended by the creation of fresh industrial centres, rather than by adding to the congestion of our already congested industrial towns. No new factory should be allowed to be built anywhere, unless there be sufficient space to house all the operatives without endangering their health or the health of the locality. Even where chawls and dwellings have been provided, they are frequently rendered dangerous by a degree of overcrowding that is inevitable in places where rents are high. However well built and designed the dwelling may have been, overcrowding produces slum conditions in which the preservation of health is impossible.

Another less obvious danger to our present large industrial centres would appear to lie in the great disturbance of the natural sex ratio. Thus, in Calcutta there are 365,000 males and only 131,000 females between the ages of 15 and 40. A certain disproportion is possibly unavoidable, but a disparity of the extent quoted would appear to be a direct health danger. It would be interesting to learn, among other things, what effect such a state of affairs has on the prevalence of venereal disease.

The question of the type of dwelling best suited to the housing of the operatives is too large a one to take up here. In certain places endeavours have been made to perpetuate the type of dwelling to which the ryot is accustomed in his village. Provided due attention be paid to the modifications demanded by health considerations, such a practice may be satisfactory; but it must not be forgotten that the sanitary régime practised in villages is the worst possible; and that the deposit of human excrement on the surface of the soil is not to be commended, and is, in fact, the direct cause of the wide prevalence of hook-worm and certain other parasitic infections. Finally, the village-type of house generally signifies a high degree of rat infestation, the dangers of which require no emphasis in plague-infected India.

If the home environment of the operatives of our factories be satisfactory, the development of industries will have an educational value, from the health standpoint, of no mean order. It would, in fact, be a gain to the cause of public health instead of being the menace which it is certain to be, unless it be more generally realised that efficient health administration is one of the most important functions of the modern state.

Other health problems.

9. In the above memorandum reference has been made to only a few of the many outstanding health problems that are intimately bound up with Indian industry. Such subjects as the effect of the expansion of communications which will accompany industrial development, on the spread of communicable disease ; the facilities that the conveyance of natural products and raw materials offers for the spread of plague ; and many cognate matters that will suggest themselves, have received no notice. All are ~~of~~ great importance. An exhaustive discussion of the whole subject was never intended, the chief object of the writer being to indicate that a large part of the relative inefficiency of Indian labour is due to removable pathological causes, and to emphasise that an efficient public health administration is essential to progress. The war has taught us that freedom from disease can be secured in spite of the most adverse environment, if the sanitarian be given a free hand. For economic and still more for philanthropic reasons "Public Health" must come into its own.

APPENDIX M.

RULES OF THE MYSORE STATE FOR THE GRANT OF LOANS GENERALLY TO FACILITATE AGRICULTURAL AND INDUSTRIAL OPERATIONS AND FOR THE PURCHASE AND ERECTION OF MACHINERY.

1. In order to facilitate agricultural and industrial operations, loans of money may be granted under these rules for any or all the purposes specified below:—

(1) for the purchase and erection of machinery for agricultural or industrial undertakings;

(2) for the construction of wells or tanks, of mills, warehouses and other structures necessary for agricultural and industrial operations;

(3) for the provision of raw material, working capital, or appliances other than those specified above required for the carrying on of industrial operations.

2. The Director of Industries and Commerce shall be competent to sanction loans not exceeding Rs. 1,000; loans of larger sums shall be granted with the sanction of Government. Loans granted for the objects specified in (1) and (3) of Rule 1 will ordinarily be subject to a limit of Rs. 10,000 and Rs. 5,000, respectively, in each case.

3. The rate of interest charged shall be 6¼ *per cent. per annum.*

4. Interest shall accrue from the date of the disbursement of the loan; or, if it is expended by the Department of Industries and Commerce, from the date on which the machinery is put in working order by that department and the borrower put in possession of the same.

5. *Period allowed for repayment and mode of recovery of loans.*—Loans shall be repayable by fixed annual payments, discharging both principal and interest.

Simple interest shall be charged on the loan, or, if it is disbursed in instalments, on these instalments, up to a date one year previous to the date fixed for commencement of repayment; and the total amount comprising the loan and such interest shall be recovered by annuities.

The time allowed for repayment of the loans and the amount of instalments shall be fixed by the Director of Industries and Commerce; but such time shall not exceed five years in the case of loans for industrial purposes and seven years in the case of loans for agricultural purposes.

The time for repayment specified above shall count from the date on which interest becomes chargeable under Rule 4 above, provided that nothing in this rule shall be taken to preclude a borrower from discharging the loan at an earlier period or from paying a larger amount than the annual instalment. The excess so paid shall be credited in reduction of principal and the number of future payments shall, if necessary, be decreased, but no reduction in the amount of the instalments fixed under paragraph 2 of this rule shall on this account be allowed.

6. The date for repayment of each instalment shall be decided by the Director of Industries and Commerce in reference to the nature of the object for which the loan is granted. But the date of the repayment of the first instalment shall not be put off for more than fifteen months from the date on which interest becomes chargeable on the loan under Rule 4 above.

7. *Postponement of repayment and remissions.*—If from causes beyond the control of the borrower the payment of any instalment becomes unduly burdensome to him, the repayment of this and all the subsequent instalments may

notwithstanding anything contained in Rules 5 and 6, be suspended by the Director of Industries and Commerce for a period of one instalment. Simple interest at 6¼ per cent. shall be charged on all suspended instalments for the period of such suspension.

8. When the work for the carrying out of which the loan is contracted fails from causes beyond the borrower's control, and when the recovery of the loan in full would occasion serious hardship to the borrower, the circumstances of the case shall be reported to Government, and such orders as Government may be pleased to pass shall be binding on the borrower.

9. On every instalment which is not paid before the close of the revenue year in which payment falls due, interest at 6¼ per cent. will be charged from the date on which payment ought to have been made. In calculating interest under this rule, a broken period of a month shall count as half a month or one month, according as it is less or not less than 15 days, and a fraction of a rupee as half a rupee or one rupee according as it is less or not less than 8 annas.

10. Repayment should ordinarily be made at the treasury of the taluk in which the work has been carried out, but with the special permission of the Director repayment may be made at any district or taluk treasury in the State.

11. *Security.*—(*a*) No loan shall be granted unless the value of the security is at least equal to the amount of the loan applied for. The nature of the security to be required of the applicant or his surety shall be the saleable interest in lands or other immovable property held by the borrower or his surety, as the case may be, provided the value of the same is at least equal to the amount of the loan applied for; in addition to which, the object upon which the loan is expended shall be mortgaged to Government as additional security.

(*b*) When a loan is applied for by a group of persons on their joint personal security, an amount not exceeding 10 times the annual assessment of the lands held by the applicants may be sanctioned at the discretion of the sanctioning authority, provided that in addition to their personal security, the applicants mortgage to Government the whole plant, machinery and buildings on the purchase and erection of which the loan is expended.

12. *Hire-purchase.*—If an applicant so desires, he may, instead of offering security of immovable property for a loan to purchase machinery for agricultural or industrial purposes, obtain the requisite machinery from the Director of Industries on the hire-purchase system on the terms specified in the form of agreement appended hereto, provided the applicant deposits with his application one-fourth of the value of the machinery he requires.

13. *Recovery of loans.*—All loans granted under these rules and all other sums falling due to Government in connection therewith, or under a contract for hire-purchase, shall be recoverable as arrears of land revenue, and a stipulation to this effect shall be inserted in every agreement executed by a borrower.

14. If, at any time, the Director of Industries and Commerce is satisfied that any person or persons who have received a loan, have failed to perform any of the conditions on which it was made, he may, after recording in writing the grounds of his decision, pass an order directing the recovery forthwith of the loan, with any interest payable thereon and costs, as an arrear of land revenue. On receipt of a certified copy of such an order, the Deputy Commissioner to whom it is communicated will forthwith proceed to recover from such person or persons any sums which may remain due together with any interest payable thereon and costs, as an arrear of land revenue: provided that, with the sanction of the Director of Industries and Commerce, such officer may, at his discretion, so recover any sum less than the whole balance of the loan without prejudice to his right to recover the remainder of such balance at any subsequent time.

15. *Mode of application.*—An application for a loan must be made in writing to the Director of Industries and Commerce on Form No. I, hereto annexed, printed copies of which will be available free of cost at all taluk offices. Every application for a loan shall contain a declaration signed by

the applicant or his surety, as the case may be, that the statements made therein regarding the nature and extent of the encumbrances on the property offered as security are true, and that there are no other encumbrances on the property to the best of his information and belief. The applicant shall also show in the column of remarks in Form I:—

(1) Whether the applicant proposes to supplement the loan by any private capital and if so, to what extent;

(2) the estimated total cost of the proposed work and the probable period that will be occupied in its construction.

16. An application for machinery on the hire-purchase system shall be in Form II appended hereto, printed copies of which will be available free of cost at all Taluk Offices.

17. *Grant of loans.*—No loan shall be granted without a local enquiry, which shall be held by a Special Officer attached to the Department of Industries and Commerce for that purpose. The result of his enquiry will be reported to the Director of Industries and Commerce, whose subsequent action in dealing with the application will be determined by the nature of the report as to the value of the security rendered. In dealing with applications for loans connected with agricultural purposes, the Director will obtain and place on record the opinion of the Deputy Commissioner of the district where the loan is to be utilised.

18. Loans will ordinarily be granted for the purchase of machinery approved by the Director of Industries and Commerce or other competent professional adviser as suitable for the purpose to which it is to be applied. Intending applicants for loans may address the Director to obtain advice, previous to submitting their applications. For the present, no fees will be charged by the Department for advice and assistance.

19. All loans will be disbursed by the Director, and it will be the duty of the borrower to put the work in hand immediately after the receipt of the loan.

The Department of Industries and Commerce will, if requested to do so, undertake the erection and starting of machinery for private individuals or firms, and will hand over the same in good working order.

20. Machinery purchased with loans obtained under these rules must be maintained in good working order to the satisfaction of the Director of Industries and Commerce, who may order repairs or renewals to be made at the cost of the owner. Failure to comply with such orders will involve proceedings for the recovery of the loan under Rule 14 of these rules.

21. *Registers and accounts.*—The Director shall keep a register of loans and repayments under these rules, including cases of hire-purchase, in a form which he will settle in consultation with the Comptroller. This register should clearly show the stage in which each transaction stands at any particular time.

22. Every loan sanctioned under these rules should be reported by the sanctioning authority to the Comptroller with full particulars. The Comptroller will see that the loan is covered by rules and sanction of competent authority and will watch the repayment of the instalments. A special section in the Comptroller's annual report on loan transactions should be devoted to loans under these rules.

FORM I.

FORM OF APPLICATION FOR LOANS.

1. Name, father's name and residence of applicant.

2. Amount of loan required.

3. Object for which the loan is required.

SECURITY OFFERED.							Name of the person who agrees to offer land or other immovable property as security and the nature and extent of his right in it.	RIGHTS OF OTHERS IN THE LAND.		Nature and extent of encumbrances, if any, in the property, where land or other immovable property is offered as security.	Whether any arrears are due on land or other immovable property offered as security.	Proposed time of repayment.	Remarks.
If personal.	*If land.*				*Other immovable property.*								
Name, father's name and residence of the surety.	Survey No.	Extent.	Assessment.	In whose name registered.	Extent.	Description.		Name, occupation and address.	Nature and extent of right.				
4	5	6	7	8	9	10	11	12	13	14	15	16	17
		A. g.	Rs. a. p.		A. g.								

NOTE.

1. Application for a loan under these rules should be made to the Director of Industries and Commerce on Form No. 1, printed copies of which will be available free of cost in all taluk offices.

2. Loans of money may be granted under these rules for any or all the purposes specified below :—

(i) Purchase and erection of machinery for agricultural or industrial undertakings, ordinarily up to a limit of Rs. 10,000 in each case.

(ii) The construction of wells and tanks, of mills, warehouses and other structures necessary for agricultural or industrial operations.

(iii) The provision of raw material, working capital, or appliances other than those specified above, required for the carrying on of industrial operations, ordinarily up to a limit of Rs. 5,000 in each case.

3. All loans granted under these rules and all other sums falling due to Government in connection therewith shall be recoverable as an arrear of land revenue.

4. The applicant will show in the column of remarks in form No. 1 :—

(i) Whether the applicant proposes to supplement the loan by any private capital and if so, to what extent ;

(ii) the estimated total cost of the proposed work and the probable period that will be occupied in its construction.

5. The rate of interest charged on the loan shall be 6¼ *per cent. per annum.*

6. Loans shall be repayable by fixed annual payments, discharging both principal and interest.

7. The time allowed for repayment shall be fixed by the Director of Industries and Commerce, subject to the limitation of a period of 5 years in the case of loans for industrial purposes and 7 years in the case of loans for agricultural purposes.

8. If the grantee of a loan misapplies the whole or any portion of the loan or otherwise fails in any of the conditions of the grant, the whole unpaid balance of the loan with interest and costs will be liable to summary recovery as an arrear of land revenue.

9. Loans for the purchase of machinery will be sanctioned, only on the condition that the machinery is approved by the Director of Industries and Commerce or other competent professional adviser as suitable for the purpose to which they are to be applied.

10. If requested, the Department of Industries and Commerce will undertake to erect the work for which the loan is obtained at the cost of the borrower and hand it over to him in good working order and with proper accounts of the expenses incurred on his behalf.

11. The machinery purchased and the buildings, etc., erected with the loan referred to above shall be maintained in a suitable condition and working order, and repairs and renewals as directed by the Director from time to time shall be carried out without undue delay.

N.B.—This is a summary of the conditions under which the loans sanctioned in Government Order No. G. 2097-145—G. M. 55-12-239, dated 2nd September 1913 are granted. For further particulars the order itself should be consulted.

FORM 2.

APPLICATION FOR MACHINERY FOR AGRICULTURAL OR INDUSTRIAL PURPOSES ON THE HIRE-PURCHASE SYSTEM.

1. Name of applicant.
2. Father's name.
3. Caste.
4. Age.
5. Residence.
6. Village, hobli, taluk and district where applicant proposes to set up the machinery.
7. Nature and description of machinery required and its approximate value.
8. Object for which the machinery is required.
9. Amount which the applicant is prepared to deposit (being ¼ of the approximate value of the machinery required).
10. Whether the applicant wishes the Director of Industries and Commerce to set up the machinery for the applicant at applicant's cost and what other help he wants from the Department in connection with the installation.

FORM 3.

ORDER GRANTING A LOAN UNDER GOVERNMENT ORDER NO. G. 2097-145—G. M. 55-12-239, DATED 2ND SEPTEMBER 1913.

I. The sum of rupees__________is granted to__________caste__________ calling__________, son of__________, residing at__________ as a loan under Government Order No. G. 2097-145—G. M. 55-12-239, dated 2nd September 1913, for the purpose of__________

____

subject to the following conditions :—

II. The conditions referred to are as follows :—

(i) That as requested by the borrower__________the amount of the loan shall be expended by the Department of Industries and Commerce on the execution of the necessary security bonds for the purpose of__________ __________ and the work handed over to the borrower__________ as soon after completion as possible in good working order with proper accounts of the expenses incurred on behalf of the borrower, or,

(ii) That the amount of the loan shall be paid to the aforesaid__________ in__________ instalments on the execution of the necessary security bonds, the first on the production of this order and the second and subsequent instalments on proof that the first and previous instalments have been properly utilised.

(iii) That if it shall appear to the satisfaction of the Director of Industries and Commerce that any portion of the first or subsequent instalments has been misapplied to any other purpose than that specified above, the portion of loan already paid to the aforesaid__________ shall be recoverable as an arrear of land revenue.

III. (i) That the loan with interest thereon at 6½ per cent. shall be repaid by equal annual instalments of Rs.__________falling due with the__________ kist of the revenue year commencing with 19__________and ending with 19__________

(ii) Such annual payments shall be made at the Treasury of__________Taluk.

(iii) If default in payments of annual instalments on account of the loan occurs or if the aforesaid__________should contravene any of the conditions under which the loan is granted, the unpaid balance of the loan shall be recoverable as an arrear of land revenue.

IV. That the machinery purchased and buildings, etc., erected with the loan referred to above shall be maintained in a suitable condition and good working order and that repairs and renewals as directed by the Director of Industries and Commerce from time to time shall be carried out without undue delay.

V. That for the repayment of the loan with interest and costs, if any, due on the same, the immovable property specified below, in addition to the object upon which the loan is expended, is hypothecated as collateral security to Government.

Signature of the officer granting the loan.

I have understood and agreed to the aforesaid terms and conditions.

Signature of borrower.

FORM 4.

HIRE-PURCHASE AGREEMENT.

An agreement made this day of 19 between the Director of Industries and Commerce on behalf of the Government of His Highness the Maharaja of Mysore (hereinafter called " the Director ") of the one part and of (hereinafter called " the hirer ") of the other part.

Whereby it is agreed as follows :—

1. The Director agrees to let on hire to the hirer, and the hirer agrees to take from the Director the machinery in the Schedule hereunder written (hereinafter referred to as " the machinery ").

2. The Director hereby acknowledges the receipt of Rs. for the option of purchase hereinafter contained. If the hirer shall exercise such option, credit will be given to the hirer for such sum. If he does not, then such sum shall belong absolutely to the Director.

3. So long as the hirer thinks fit to continue the hiring, he shall pay for the hire of the said machinery to the Director at Bangalore, without demand, the sum of Rs. every six months with interest on the amount of hire for the time being unpaid at the rate of *per cent. per annum.* The first payment of Rs. together with the interest which shall have accrued and be payable as aforesaid to be made on the day of 19 , the second payment of Rs. and interest as aforesaid to be made on the day of 19 , and the third payment of Rs. and interest as aforesaid to be made on the day of 19 , and the fourth payment of Rs. and interest as aforesaid to be made on the day of 19 , (and so on).

4. It shall be lawful for the Director and all persons authorised by him, at all times to enter upon any premises in which the machinery may be for the time being, to examine the same.

5. The hirer agrees with the Director that during the hiring—

(*a*) the machinery shall be kept in good and serviceable order and condition (also without damage by fire) and that no alteration or addition thereto shall be made without the previous written consent of the Director;

(*b*) the machinery shall be kept in possession of the hirer and upon trust for the Director at the hirer's address given in the Schedule hereto, or at such other addresses as the Director may by writing authorise, free from distress, execution, or other legal processes, and shall not on any account be sold, assigned, or dealt with, or the possession thereof parted with;

(*c*) all rates, taxes and outgoings payable in respect of the premises wherein the machinery may for the time being be placed shall be duly and punctually paid and discharged by the hirer, and the current receipts therefor shall be produced to the Director on demand.

6. It is hereby declared that the Director has entered into this agreement upon the express declaration by the hirer, and the hirer hereby expressly warrants, that the premises upon which the machinery is to be placed are free from any mortgage incumbrance or charge given or created by the hirer, or any person through whom he claims.

7. If the hirer at any time during the hiring shall be desirous of executing or creating any charge, mortgage or other incumbrance of or upon the premises in or upon which the machinery shall for the time being be, he shall give to the Director one calendar month's previous notice in writing of his intention so to do, and upon the receipt of such notice it shall be lawful for the Director to put an end to the hiring in manner provided by the next succeeding clause.

8. If the hirer—

(*a*) shall make default in punctually paying any hire instalment or

(*b*) shall be adjudicated bankrupt or shall file a petition in insolvency or enter into any arrangement or composition with his creditors or

(*c*) shall execute or create any mortgage incumbrance or charge of or upon the premises in or upon which the machinery may for the time being be, or give notice of his intention so to do, as provided by the last preceding clause or

(*d*) shall fail to observe and perform any of the agreements and conditions contained in this Agreement and on his part to be observed and performed,

then, and in any such case, it shall be lawful for the Director to immediately put an end to the hiring, and for that purpose the hirer hereby authorises the Director or any one deputed by him to enter upon any premises in which the machinery may be for the time being, and to seize and take away the same.

9. Should the hirer hinder or prevent the Director or his Deputy seizing and taking away the machinery, then, and in every such case, the hirer shall pay to the Director the sum of Rs. 200 (two hundred rupees) as and by way of liquidated damage for breach of this provision and not by way of penalty.

10. If the Director shall seize and take possession of the said machinery under clause 8 hereof, the hirer shall have the option within one month after such seizure of purchasing the said machinery by the payment to the Director of Rs. together with the costs and expenses of and incidental to such seizure. In the event of the hirer making such payment within the time aforesaid he shall receive credit from the Director for all sums previously paid by him on account of hire and the amount paid on the signing of this agreement. If the hirer shall not exercise such option and make such payments within the time aforesaid, the option given to the hirer by this clause shall cease, and the hirer shall not be entitled to any credit, allowance or return for or on account of any payments made previously by him.

11. No allowance, return, credit or payment, shall be allowed or paid to the hirer in the event of the hiring being determined by the Director as provided by clause 8 hereof, but the

hirer shall pay to the Director at Bangalore all arrears of hire, interest and damages, for the breach of this agreement up to the date of such determination.

Such damages shall be in addition to and not in substitution of any damages mentioned in clause 9 hereof.

12. All sums falling due to the Director under this contract shall be recoverable from the hirer as an arrear of land revenue.

13. The Director hereby agrees that the hirer shall have the option of purchasing the machinery at any time during the hiring by paying the sum of Rs.________with interest thereon at____*per cent. per annum* from the date hereof, and also that if the hirer shall exercise such option he will give to the hirer credit against such purchase price for all payments which shall have been made by him for hire, with counter interest on such payments at the like rate and also for the sum paid on the signing of this agreement. But until such purchase price shall have been paid in full, the said machinery shall remain the absolute property of the Government of Mysore.

14. If the Director shall grant to the hirer any time or indulgence, the same shall not affect or prejudice the Director's rights under this agreement.

____

Director's signature.

____

Hirer's signature.

Witness to signature of the said

Signature________________

Address________________

Occupation________________

(Schedule above referred to)

Machinery.

Address for the purpose of clause 5 (*b*)

District Town Street Number of house.

FORM 5.

MORTGAGE DEED TO BE EXECUTED BY THE BORROWER.

THIS instrument made the________________day of________191__________between ______________________of__________(hereinafter called "the Mortgagor") of the one part and the Director of Industries and Commerce on behalf of the Government of His Highness the Maharaja of Mysore (hereinafter called "the Mortgagee") of the other part.

WHEREAS the Mortgagor $\frac{\text{has}}{\text{have}}$ received from the Director of Industries and Commerce ______________________________________an order under the Rules for the grant of Loans generally to facilitate Agricultural and Industrial Operations issued under Notification No. G. 2146—G. M. 55-12-240, dated 2nd September 1913 ______________________________________and dated the ______________day of__________191______in virtue of which the Mortgagor $\frac{\text{is}}{\text{are}}$ entitled to receive the aggregate sum of Rs.__________as a loan from the Mortgagee for the purpose of ______________________________________and WHEREAS security for the due application of the amount of the said loan and for the punctual repayment of the same according to the terms of the said order is demanded by or on behalf of the mortgagee and in order to furnish such security the Mortgagor has agreed to sign these presents.

NOW THESE PRESENTS WITNESS that in consideration of the said loan and in pursuance of the said agreement the Mortgagor doth hereby transfer to the Mortgagee, his successors and assigns the immovable property described in Schedule A hereunder written with the appurtenances thereto subject to redemption as hereinafter mentioned.

THESE PRESENTS ALSO WITNESS that in consideration of the said loan and in pursuance of the said agreement the Mortgagor doth hereby further transfer to the Mortgagee, his successors and assigns the property described in Schedule B hereunder written, being that on which the said loan is to be expended, subject to redemption as hereinafter mentioned.

AND it is hereby agreed that if the Mortgagor, $\frac{\text{his}}{\text{their}}$ legal representatives and assigns shall duly comply with the terms on which the said loan has been granted and shall apply the same and every part thereof in the manner provided in the said order and shall duly repay the amount of the said loan together with any interest which may have become payable thereon or on any part thereof and all costs if any incurred by the Mortgagee, his successors or assigns in making the said loan or otherwise in connection therewith, the Mortgagee, his successors or assigns shall thereupon retransfer the said immovable property noted in Schedule A together with the property described in Schedule B to the Mortgagor, his legal representatives or assigns or as he or they shall direct.

PROVIDED always and it is hereby agreed that in case the Mortgagor, his legal representatives or assigns shall fail to comply with the terms on which the said loan has been granted it shall be lawful for the Mortgagee, his successors and assigns to sell the said immovable property noted in Schedule A and the property described in Schedule B or any parts thereof and out of the proceeds of such sale to make good to the Mortgagee, his successors or assigns the amount which in consequence of any such default shall be payable by the Mortgagor, his legal representatives or assigns.

In witness whereof the Mortgagor $\frac{\text{has}}{\text{have}}$ hereunto set $\frac{\text{his}}{\text{their}}$ hand the day and year first above written.

The schedule above referred to.

SCHEDULE A.

			IF THE PROPERTY IS HOUSE PROPERTY.				IF CULTIVABLE LAND.				
Registration District.	Registration Sub-District.	Village.	Boundaries of the property.	Description and value of buildings and how long likely to last.	Extent of building site and of vacant ground or compound.	Trees, wells, etc.	Survey number.	Wet or dry.	Extent.	Assessment.	Trees, wells, etc.
1	2	3	4	5	6	7	8	9	10	11	12

SCHEDULE B.

Registration district.	Registration Sub-District.	Village.	Description of objects upon which the loan is expended.

(Signature of borrower)

Witness.

(1) ____________________, son of ____________________, Village of ____________.

(2) ____________________, son of ____________________, Village of ____________.

Signed by the above mentioned
in the presence of

FORM 6.

SECURITY BOND TO BE EXECUTED BY A SURETY FOR A BORROWER.

THIS INSTRUMENT MADE the ____________________ day of ____________ 19______ between ____________________ of ____________________ (hereinafter called "the Mortgagor") of the one part and the Director of Industries and Commerce on behalf of the Government of His Highness the Maharaja of Mysore (hereinafter called "The Mortgagee") of the other part.

WHEREAS________________ $\frac{\text{has}}{\text{have}}$ received from the Director of Industries and Commerce________________________________an order under the Rules for the grant of loans generally to facilitate agricultural and industrial operations issued under Notification No. G. 2146—G. M. 55-12-240, dated 2nd September 1913, and dated the________________day of ________________19____ in virtue of which the said________________ $\frac{\text{is}}{\text{are}}$ entitled to receive the aggregate sum of Rs.____________as a loan from the Mortgagee for the purpose of________________________

AND WHEREAS security for the due application of the amount of the said loan and for the punctual repayment of the same according to the terms of the said order is demanded by or on behalf of the Mortgagee and in order to furnish such security the Mortgagor has agreed to sign these presents.

NOW THESE PRESENTS WITNESS that in consideration of the said loan and in pursuance of the said agreement the Mortgagor doth hereby transfer to the Mortgagee, his successors and assigns the immovable property described in the Schedule hereunder written with the appurtenances thereto subject to redemption as hereinafter mentioned.

AND it is hereby agreed that if the said____________ $\frac{\text{his}}{\text{their}}$ legal representatives and assigns shall duly comply with the terms on which the said loan has been granted and shall apply the same and every part thereof in the manner provided in the said order and the said ________________ $\frac{\text{his}}{\text{their}}$ legal representatives or assigns or the Mortgagor or his legal representatives shall duly repay the amount of the said loan together with any interest which may have become payable thereon or on any part thereof and all costs if any incurred by the Mortgagee, his successors or assigns in making the said loan or otherwise in connection therewith, the Mortgagee, his successors or assigns shall thereupon retransfer the said immovable property to the Mortgagor, his legal representatives or assigns or as he or they shall direct.

PROVIDED always and it is hereby agreed that in case the said________________ $\frac{\text{his}}{\text{their}}$ legal representatives or assigns shall fail to comply with the terms on which the said loan has been granted, it shall be lawful for the Mortgagee, his successors and assigns to sell the said immovable property or any part thereof and out of the proceeds of such sale to make good to the Mortgagee, his successors or assigns the amount which in consequence of any such default shall be payable by the said________________ $\frac{\text{his}}{\text{their}}$ legal representatives or assigns.

PROVIDED also and it is hereby agreed that although as between the said________________ ________________ and the Mortgagor, the Mortgagor is surety only for the said________________ yet, as between the Mortgagor and the Mortgagee, the Mortgagor is to be considered as principal debtor for the principal moneys, interest and costs intended to be hereby secured so that the Mortgagor or his legal representatives shall not be released or exonerated by time being given to the said________________ $\frac{\text{his}}{\text{their}}$ legal representatives or by any other dealings act, matter or things whatsoever whereby the Mortgagor or his legal representatives as surety or sureties only for the said________________and $\frac{\text{his}}{\text{their}}$ legal representatives would be so released or exonerated.

In witness whereof the Mortgagor has hereunto set his hand the day and year first above written.

Signature of surety.

Witnesses.

APPENDIX N.

EAST INDIAN RAILWAY.

Proposed Technical School at Jamalpur.

I.—PRESENT SYSTEM OF TRAINING.

European and Anglo-Indian apprentices.

At Jamalpur, European and Anglo-Indian apprentices are engaged on a five years indenture as the result of an open competitive examination. During the five years they receive practical training as workmen in the workshops and attend a technical school for 4 hours per week at which they are taught a certain amount of elementary theory by masters, who are members of the Locomotive Department staff, and who receive allowances for this work. The apprentices live in a hostel where they pay for their board and lodging—the payments for this and for tuition in the school being rather more than covered by the stipend given to them by the railway.

The following shows their monthly salary and expenses :—

Jamalpur Locomotive Department.	First year.	Second year.	Third year.	Fourth year.	Fifth year.
	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs A. P.
Rate of pay	30 0 0	30 0 0	35 0 0	40 0 0	50 0 0
Deductions.					
Provident Fund . . .	...	...	...	3 5 0	4 3 0
Institute	0 4 0	0 4 0	0 4 0	0 4 0	0 8 0
Recreation Club . . .	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0
Technical School . . .	1 8 0	1 8 0	1 12 0	2 8 0	2 8 0
Total deductions .	2 12 0	2 12 0	3 0 0	7 1 0	8 3 0
	27 4 0	27 4 0	32 0 0	32 15 0	41 13 0
Board and lodging . .	36 0 0	36 0 0	36 0 0	36 0 0	36 0 0
Amount billed for against the apprentices.	8 12 0	8 12 0	4 0 0	3 1 0	...

On completion of their five years apprenticeship, these boys are appointed as fitters or boiler-makers, commencing on a salary of Rs. 110 to Rs. 130 per mensem and rising by the 6th year to Rs. 210 or Rs. 230. The initial salary may be increased at the discretion of the Locomotive Superintendent in accordance with the value he assigns to their work.

Indian apprentices.

2. Indian apprentices are also appointed in the workshops of two classes the first class commencing at Rs. 10 and rising to Rs. 15 in the 5th year of apprenticeship, and the second class, usually consisting of sons of workmen in the shops, commencing on Rs. 4 per mensem and reaching Rs. 9 per mensem in the 6th year. In both classes the apprentices are bound by a stamped agreement; in the former to serve for five years and in the latter for six years.

Evening classes of instruction were formerly arranged for these Indian apprentices, but, mainly because of the difficulty of attendance, their homes being in outlying villages, this was found to be impracticable and they have been dropped.

II.—REASONS FOR IMPROVEMENT.

Disadvantages of present system.

3. Under this system it is found that the European and Anglo-Indian lads who, in the absence of recruitment from England, must form the recruiting ground for the subordinate supervising staff of the workshops, do not get so complete and substantial a training as is the case in men of a similar class imported from England. This is ascribed to three causes:—

(1) Inadequate time for theoretical instruction of a thorough nature;

(2) Inadequate supervision of their practical work in the workshops;

(3) Disadvantages connected with the environment in which they are brought up as compared with the conditions of training in Britain, which conduce to self-reliance and development of character.

It is also to be noticed that the system makes no provision for the training of suitable Indians for recruitment as superior mechanics and the subordinate supervising staff of the workshops; nor for the training of apprentices in the Engineering Department, who at present receive little or no theoretical training.

Objects to be secured.

4. In view of the difficulties which will assuredly be experienced in recruiting mechanics and men for the subordinate supervising staff of the workshops in Britain, and also the desirability of making the best use of the material at hand, both European and Indian, it is considered essential that the facilities for training should be extended and improved.

Further it is desirable, in the interests of the country at large, that opportunity should be taken of the very valuable practical training which is available in large workshops such as those at Jamalpur to train up a class of men who will be able to take posts in other mechanical industries similar to those of the foremen and assistant foremen in the workshops, with a view in some cases to proceeding to further training and qualifying for supervising posts in such industries.

Lastly, it is desirable that more attention should be paid to the early education of Indian lads who wish to become workmen in the shops, and also to afford some means of elementary technical education to such of the younger workmen as are capable of assimilating it, so as to improve the general intelligence and, therefore, the value of this class.

III.—PROPOSED IMPROVEMENTS.

Outline of proposals.

5. The scheme now proposed is therefore designed:—

(1) To improve the training of Locomotive Department apprentices—

(a) by a better distribution of time between practical and theoretical training;
(b) by an improved theoretical course;
(c) by better supervision and arrangement of the practical course in the shops.

(2) To provide similar training for an additional number of Indian apprentices in the Locomotive Department.

(3) To provide training for apprentices in the Electrical Department and in the permanent-way works, signalling, block signalling and drawing office branches of the Engineering Department.

(4) To provide elementary theoretical technical training in the vernacular for some of the younger workmen out of workshops hours.

(5) To provide training, practical and theoretical (in the vernacular) for boys who will become workmen, and

(6) To arrange for suitable primary education for those who wish to benefit by proposal (5) (as a future extension of the scheme to provide for an even flow of recruits).

Apprentices.

6. For the first three portions of the scheme described above, it will be necessary to build a new school and provide a whole-time well-qualified staff. The apprentices would spend roughly half their time in the workshops and half their time in the school, the work in the school being co-ordinated with the practical work in the shops. During the time they are in the workshops, they would be under the supervision of a special instructor, and their work would be arranged in a progressive manner so as to cover all branches of workshop work.

The Engineering Department apprentices would have a simplified course of study and, in place of part of the workshop work in the second year, would do practical work relating to the particular branch for which they have been appointed.

For the Indian apprentices, a separate hostel would have to be provided, but in other respects the boys would all work together, and no distinction would be made in the training between Europeans and Indians.

Numbers.

7. The present number of Locomotive Department apprentices engaged annually varies from 20 to 25 according to the probable requirements of recruiting in the workshops at the end of the fifth year, the number of boys under training at any one time being approximately 90.

The school should in addition provide for an annual recruitment of 10 to 12 Indian Locomotive apprentices per annum, which, allowing for wastage, would mean an addition of perhaps 45 students by the fifth year.

For the Engineering Department it is proposed that all apprentices in the permanent-way works, drawing office, signalling and block signalling branches should put in a two years course of training at Jamalpur. The average annual rate of recruitment is estimated at 10 and this would mean an addition of 20 students to the school.

The Electrical Department would appoint, say, 2 to 3 apprentices per annum, meaning an addition of 5 to the numbers.

The total number of apprentices to be dealt with would accordingly be 115 in the first year after the opening of the school, rising until the full number of 160 was reached in the fifth year, after which the numbers would be about stationary at this figure.

If the time of the apprentices were divided between practical and theoretical work in the proportion of 60 per cent. to 40 per cent., it would be necessary to provide school accommodation for, say, 65 boys and to arrange for the training of 95 boys at a time in the workshops.

Workmen and boys.

8. For the elementary vernacular technical instruction, which it is intended to give to younger workmen and boys, it is necessary to provide an industrial school, as a branch of the technical school. Classes in mensuration,

drawing, arithmetic, etc., would be given by junior members of the staff of the school to selected workmen, the time being given out of workshop hours.

The industrial school would provide simple education in the vernacular in drawing, mensuration, etc., for about 3 or 4 hours a week in workshop hours to some of the boys who are commencing their career in the workshops as workmen. The education would be free, and successful passing of each year's examination would be recognised by a small rise of salary. The industrial school would thus provide an alternative to boys who at present pass from the Upper Primary Schools to the Middle English and High English Schools.

The numbers in the industrial school would eventually be large if the results were satisfactory, but it is proposed to commence with accommodation for 50 boys in the first instance.

IV.—MANAGEMENT AND FINANCE.

Committee of Management.

9. The whole of the technical education scheme would be under the management of a Committee, of which the Locomotive Superintendent would be the Chairman and the Principal of the school the Secretary. The other members should be the Works Manager, the Electrical Engineer, the Chief Engineer, or his representative, one other Locomotive Department officer appointed by the Locomotive Superintendent, an Indian railway officer selected by the Agent, and a representative of the Bihar and Orissa Government (either Educational Department or Industrial Department, when constituted).

The initial expenditure and subsequent additions would be met from railway capital with the assistance of grants from the Bihar and Orissa Government, and the recurring expenditure would be met from railway revenue and annual grants from the Bihar and Orissa Government.

The building and equipment would be the property of the railway, and the staff would be railway servants. The income and expenditure would be dealt with under the orders of the Committee, but it would be preferable if they could form a part of the railway budget instead of being kept separate and vested in the Committee.

V.—STAFF.

Cadre of Staff.

10. The following staff is suggested :—

Monthly Salary.

	Rs.	Rs.
Principal	1,000 to 1,500	2,750 to 4,000
Assistant Master	600 „ 800	
Ditto	400 „ 600	
2 Junior Masters	150 „ 250	
Workshop Instructor	450 „ 600	
Demonstrators, etc.	300	650.
Clerical staff	250	
Menial staff	100	
Hostel Superintendent	200 to 300	300 to 450.
Indian Deputy Hostel Superintendent	100 „ 150	

The Principal and the two senior masters should be appointed by the Board of Directors and be officers of the railway. The appointment of all other members of the staff should be in the hands of the Committee.

11. The Principal should be a man with an engineering degree from a British University or a recognised British engineering college. He should be an Associate Member of the Institution of Civil Engineers or Mechanical Engineers, and should have had some years of experience in teaching as well as workshop training. It would be an advantage if he had already been some years in India. **Principal.**

As the success of the scheme depends very much on its direction in its early stages, it is important that the Principal should be a man capable of building up and developing the constitution of the school, both as regards staff and equipment, and who could advise and suggest the details of the design of the building and organisation.

12. The two senior assistant masters should possess the same educational qualifications as the Principal, but need not have had so much experience in teaching, and it is not essential that they should have had workshop training. One of them should be specially qualified in mathematics, physics and allied subjects, and the other in drawing and applied mechanics. They might be obtainable in India, and be of the class generally recruited for the Educational Department. **Assistant masters.**

13. The junior assistant masters should be qualified to teach the more elementary subjects, such as arithmetic, drawing in the early stages and elementary science. They would be of the type appointed to the Provincial Educational Service.

14. The workshop instructor should be a man of the foreman class, and it is possible that a suitable man might be found amongst the foremen in the Locomotive workshops, who could be given an allowance over and above his salary, bringing his pay up to, say, Rs. 600. His duties would be to arrange and supervise the work of the apprentices in the workshops, under the direction of the works manager. The first year, apprentices would require to receive regular instruction under the instructor on an approved course, so as to become acquainted with the use of tools. Later they would be drafted into the various shops and work under the foremen of those shops. During the whole time, however, the instructor would require to watch their work and see that they were making the best use of their time. The workshop instructor would work under the orders of the Works Manager in all matters connected with the presence of the apprentices in the workshops. **Workshop instructors.**

15. The school would require a small number of demonstrators, etc., to assist the teaching staff in the practical work and drawing, etc. It is estimated that they would cost Rs. 300 per mensem. **Minor staff.**

The Principal would have an office supervised by a head clerk and accountant on, say, Rs. 150, with one or two assistants, the whole costing Rs. 250 per mensem.

VI.—HOSTELS.

16. The present European hostel will accommodate 95 apprentices. Of the Engineering Department apprentices, it is estimated that half or 10 might be Europeans, and one or two of the Electrical apprentices will also be Europeans. It will be necessary, therefore, to provide accommodation for 10 additional European lads, which may be estimated to cost Rs. 10,000. **Europeans.**

17. The Indians for whom accommodation will be required will be 45 Locomotive Department, 10 Engineering Department and, say, 1 Electrical Department or 56 in all. The accommodation for the Indians should be arranged as in the present European hostel, *i.e.*, rooms containing 8 or 10 **Indians.**

beds for the younger apprentices and rooms with 4 or 2 beds for the Seniors. Lavatories and bath rooms would be built in an outlying block with a covered way. To give facilities for separate messing of the different castes, it would be necessary to have at least four mess rooms each with its separate cook room. At a rough approximation, such a building including furniture is estimated to cost Rs. 50,000.

Messing.

18. It is proposed that messing and living accommodation should be provided free for both Europeans and Indians, though it is possible that it might be found convenient in the Indian hostel to give a monthly allowance to each mess and let the apprentices make their own arrangements for cooking, etc., under the supervision of the Superintendent.

The cost of the present board inclusive of staff, etc., for Europeans is approximately Rs. 36 per head per mensem, or, say, Rs. 3,780 per mensem for 105 boys. The board for Indians would be less costly and might be put down at Rs. 15 per mensem per head, which for 56 boys would be Rs. 840 per mensem. Thus the monthly cost of the two hostels, in addition to the salaries of the Superintendent and Deputy Superintendent, would be Rs. 4,620 per mensem.

Hostel staff.

19. It would be necessary to have a capable European as Hostel Superintendent with full charge over all the catering and domestic arrangements, with an Indian Deputy Superintendent for the Indian hostel.

VII.—School Building.

School building.

20. The building should contain the following accommodation :—

One large lecture room.
Two smaller lecture rooms.
Laboratory for applied mechanics, etc.
Laboratory for chemistry and metallurgy.
Drawing office.
Principal's room.
Masters' common room.
Office.
Lavatory in outside building.

To this would have to be added a room for the industrial school, if it is considered desirable to hold this in a separate room.

From a rough design of such a building it is estimated to cost Rs. 70,000.

Furniture may be estimated at Rs. 10,000 and equipment and apparatus at Rs. 20,000, making the total cost of the School approximately Rs. 1,00,000.

Site.

21. As regards the site, this should be chosen so as to be conveniently situated for access to the workshops, but there must be room for expansion, and it should not be so close to the workshops that the noise would be a cause of annoyance and interruption to work. A proposal has been made that the school should be within the workshop enclosure, on the space near the Electrical Engineer's office. This site would, however, be noisy and dusty, and it is questionable whether all existing space within the workshop enclosure should not be reserved for future extensions.

VIII.—Accommodation for Staff.

Staff buildings.

22. The staff will be provided with house accommodation, for which they will have to pay rent under railway rules.

The following new houses will be required :—

Staff.	Houses.	Estimated cost.
		Rs.
(1) Principal	One bungalow of the type built for District Officers.	30,000
(2) Assistant Masters	2 five-roomed bungalows as built for Assistant District Officers.	40,000
(3) Workshop Instructor	1 four-roomed bungalow as built for senior subordinates.	15,000
(4) Junior Assistant Masters	2 three-roomed bungalows as built for senior subordinates.	20,000
(5) Demonstrators and clerical staff.	3 sets senior Indian subordinates' quarters	3,600
	4 set clerks' quarters	3,000
(6) Menial staff	12 sets menials' quarters	3,600
	Total Rs.	1,15,200

The total estimated cost of Rs. 1,15,200 does not include cost of land, as sites can probably be found on railway land, but out-houses, water supply and electric equipment should be able to be provided from the above sum.

IX.—COURSES OF INSTRUCTION.

23. *Theoretical.*—The first year's course for all apprentices would be mainly directed towards making good deficiencies in previous education, in the direction of mathematics, applied mechanics, elementary physics and chemistry, and drawing. **First year.**

For the Locomotive Department apprentices the remaining four years would be employed in a progressive course in drawing, applied mechanics and mechanism, mathematics, elementary electricity and magnetism, physics and chemistry, and general knowledge. **Locomotive apprentices.**

In the last year some instruction could be given in general subjects, such as workshop methods, workshop organisation and accounts, machine design, etc.

The Engineering Department apprentices in the second year would have special courses in the subjects of their particular branches— **Engineering apprentices.**

(*a*) for P. W. I. apprentices, on lay-out of points and crossings, etc., and maintenance of road;

(*b*) for Inspector of Works apprentices, building construction, strength of materials, elementary bridge and roof construction, simple accounts, estimating and surveying;

(*c*) for Signal apprentices, interlocking and signalling and station working rules;

(*d*) for Block Signal apprentices, electricity as applied to telegraphs, telephones and block instruments and station-working rules;

(*e*) for Drawing office apprentices, design of buildings, and bridges, computation of quantities, estimating and surveying.

Electrical apprentices. For the Electrical Department apprentices, the course in the last four years would be based on that given to Locomotive Department apprentices, but special courses would be given in electricity, and the general maintenance and up-keep of electrical plant, wiring, etc.

First year. 24. *Practical.*—In the first year all apprentices would go through a graded course of practical workshop work, the object being to acquaint them with the use of tools.

Locomotive apprentices. During the next three years the Locomotive Department apprentices would be posted to different shops in turn and have to work as workmen under the foremen of the shops, the object being to give them as wide a knowledge of workshop methods as possible.

In the last year the Locomotive Department apprentices might be allowed to specialise in any one shop, for the work of which they had shewn a special fitness.

Engineering apprentices. For the Engineering Department apprentices in the second year, special practical courses would be arranged for each branch.

(*a*) P. W. I. apprentices would work practically on linking, maintenance and lay-out of permanent way and points and crossings under an experienced permanent-way inspector and also on building construction.

(*b*) Inspector of Works apprentices would be taught practical surveying and setting out, building construction and use of tackle, working with their own hands.

(*c*) Signal Inspector apprentices would work as fitters in the signal shop and also be given practical experience in erecting signals and interlocking gear.

(*d*) Block Signal apprentices would receive practical training in constructing and repairing telephone and block instruments, testing lines, etc.

(*e*) Draughtsmen apprentices would receive practical instruction in surveying, levelling plotting and estimating on actual works.

Electrical apprentices. The Electrical Department apprentices would receive their last four years practical training in the Electrical Department workshops and the power house and other allied work.

X.—RECRUITMENT.

25. Recruitment for posts as apprentices in all three departments will be on the results of an examination coupled with selection. Candidates for examination should not be under 16 nor over 19 years of age.

Examination. The principal will hold an annual open examination. Before entering, each candidate will be required to say which branch of the service he wishes to join. After the examination every candidate will be examined for physical fitness and a report on his health made by the Railway Medical Officer.

Selection. 26. The Locomotive Superintendent, Chief Engineer, and Electrical Engineer will then select from the lists, after personal interviews or interviews with a selection board whichever may be found most suitable. The candidate's place on the examination list and his physical fitness will be taken into consideration, but selection will largely depend on his general level of intelligence, strength of character and the impression he makes at the time of his personal interview.

A candidate would have the option of putting down his name for more than one department, and in that case he would come up for selection for the different departments in the order in which he places them in his application.

Standard of examination.

In view of the different systems on which the education of Europeans and Indians is at present conducted, it is doubtful whether for some time to come it would be possible to have the same examination for both. The proportions of actual recruitment must depend largely on the vacancies in the hostels and school and, provided the examination secures that the selected candidates have the necessary education to assimilate the work at the school, it is not of much importance whether the same papers are set to Europeans and Indians. It is suggested that the standards adopted should be roughly the Junior Cambridge for Europeans and the Matriculation for Indians.

XI.—COST OF SCHEME.

Initial cost.

27. The initial cost of the scheme may be summarised as follows:—

	Rs.
School building	70,000
Furniture and equipment	30,000
Hostels (1) Addition to Europeans	10,000
(2) For Indians	50,000
Houses for staff	1,15,200
Total	2,75,200

Recurring cost

28. The recurring cost is estimated as follows:—

	Monthly. Rs.	Annual. Rs.
Staff	5,100	......
Stipends of apprentices 160 at Rs. 15	2,400	......
Board of apprentices—		
European 195 at Rs. 34	3,570	......
Indian 56 at Rs. 15	840	......
Up-keep of equipment and apparatus and stores	300	......
Contingencies of school	100	......
Ditto hostel	100	......
Monthly	12,410	......
Total annual	......	1,48,920

or say Rs. 1,50,000 per annum.

The initial annual expenditure will be somewhat less than this, or say Rs. 1,20,000 in the first year.

Present expenditure.

29. The present expenditure on the training of apprentices is approximately as follows:—

	Monthly. Rs.	Annual. Rs.
Salaries—		
Locomotive Department	3,600	......
Electrical ,,	330	......
Engineering ,,	870	......
	4,800	
		57,600
School grant	50	600
Total annual expenditure	......	58,200

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CALCUTTA: PRINTED BY SUPDT. GOVT. PRINTING, INDIA, 8, HASTINGS STREET.

EAST INDIA (INDUSTRIAL COMMISSION).

REPORT

OF THE

INDIAN INDUSTRIAL COMMISSION,

1916–18.

Presented to Parliament by Command of His Majesty.

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1919.

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